AES Indiana

Petersburg BESS Project

Issue: Rev 0

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Exhibit F

BESS Scope of Work and Technical Requirements

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1.0 PROJECT DESCRIPTION

AES Indiana, previously Indianapolis Power and Light, (Owner) is requesting proposals from qualified firms for the complete delivery of a battery energy storage system (BESS). The Petersburg BESS Project (Project) consists of two 100 MW and 400 MWh BESS installations. The Project will be located on the grounds of the 2,146 MW, coal-fired Petersburg Generation Station (Petersburg Generating Station or Facility), which is currently owned by AES Indiana.

The Project is anticipated to be interconnected to the nearby AES Indiana transmission line through the new AES Indiana substation. A new AES Indiana substation (contracted separately) will serve as the point of interconnect (POI) that will tie-in to the new interconnection switching station. The Project is anticipated to participate within the Midcontinent Independent System Operator (MISO) regional transmission organization. The Project will interconnect to a new AES Indiana collector substation at 34.5 kV. The new AES Indiana collector substation will interconnect to the existing Petersburg Generating Station switchyard via a 345 kV overhead gen-tie line. Additional details on Project ratings and substation and interconnect voltages are provided in Table 1-1.

The Project Scope of Work and Work requirements are defined in the following sections of this Exhibit F – Scope of Work, its referenced Attachments, and referenced Contract Exhibits.

Table 1-1. Project Size and Voltage Ratings

Design Parameter	Value
Nameplate Power Rating (at POI)[1]	200 MW
Nameplate Rating (at substation), minimum[2]	235 MVA
Nameplate Energy Capacity Rating at Design Depth of Discharge (DoD)	800 MWh
AC Round-Trip Efficiency (100% DoD cycle)[3]	Minimum 85%
Availability[4]	99% annual availability
Project Lifetime	20 Years
Seismic	Per Exhibit F – Scope of Work Section 3
Interconnect Voltage	345 kV

1. Limited by BESS power plant controller.
2. Output of battery inverters shall include power factor, AC losses, and transformer losses, and MISO requirements to result in 200 MW at point of interconnection.
3. AC round trip efficiency of the BESS is defined as the ratio of the delivered discharge energy to the delivered charge energy at the Facility's high voltage POI, including auxiliary power losses.
4. Availability is defined as the percentage of time that the entire BESS is available for operational service (charging, discharging, or in storage mode) and not removed from service for maintenance or due to failure.

Figure 1-1. Project Site Location

2.0 SCOPE OF WORK

The Work provided by Contractor shall include all work (except for those items specifically excluded) required to deliver a Project capable of operating in accordance with applicable laws and permits, the Generator Interconnection Agreement (GIA), and the Project schedule. Contractor's Scope of Work shall include the engineering, design, procurement, delivery, installation, construction, commissioning, startup, and testing as necessary to deliver the commercially operational Project in accordance with Table 2-1. Scope of Work Matrix below, Table 2-2. Owner Supplied Equipment, and the associated requirements of this Exhibit F. Contractor shall design and construct the Project in accordance with this Exhibit F, Scope of Work, and all of the appendices attached. Contractor shall coordinate interface points with substation contractor scope of work. The following equipment, material, and services at a minimum shall be included in the Work.

Table 2-1. Scope of Work Matrix

Item No.	Description	Engineer and Design and Technical Selection	Procure and Supply	Construct, Install, and Implement	Commission, Startup, and Test
1.	**Equipment, Components, and Materials**				
1.1.	Direct Current (DC) Electrical Power Collection Systems	Contractor	Contractor	Contractor	Contractor
1.2.	Power Conversion System Foundations	Contractor	Contractor	Contractor	Contractor

Item No.	Description	Engineer and Design and Technical Selection	Procure and Supply	Construct, Install, and Implement	Commission, Startup, and Test
1.3.	Power Conversion Systems	Contractor	Contractor	Contractor	Contractor
1.4.	Battery Enclosures	Contractor	Contractor	Contractor	Contractor
1.5.	BESS Supervisory Control and Data Acquisition (SCADA) Control Systems (Hardware)	Contractor	Contractor	Contractor	Contractor
1.6.	BESS SCADA Programming	Owner	-	Owner	Contractor
1.7.	BESS Energy Management System (EMS)	Contractor	Contractor	Contractor	Contractor
1.8.	Intra-Site Communications Infrastructure	Contractor	Contractor	Contractor	Contractor
1.9.	Essential Power Supply System	Contractor	Contractor	Contractor	Contractor
1.10.	Labels – National Electrical Code (NEC), Occupational Safety and Health Administration (OSHA), Arch Flash and Associated Data per Arch Flash Studies, and Other Code Required Labels for Equipment and Areas – See Section 8.1.5	Contractor	Contractor	Contractor	Contractor
1.11.	Labels – Equipment, Panels, and Cabling	Contractor	Contractor	Contractor	Contractor
1.12.	Structural Foundations for All Equipment, Panels, and Enclosures	Contractor	Contractor	Contractor	Contractor
1.13.	Mechanical Systems and Equipment	Contractor	Contractor	Contractor	Contractor
1.14.	Raceway and Miscellaneous Services	Contractor	Contractor	Contractor	-
1.15.	Power and Instrument Cable	Contractor	Contractor	Contractor	Contractor
1.16.	Instrument Cabinets and Local Control Panels	Contractor	Contractor	Contractor	Contractor
1.17.	Local Instrument Cabinets and Racks	Contractor	Contractor	Contractor	Contractor
1.18.	Site Storage Building(s) and Enclosure(s)	Contractor	Contractor	Contractor	-
1.19.	Site Grounding and Lightning Protection Systems	Contractor	Contractor	Contractor	Contractor
1.20	Site Security Fence, Gate System, and Lighting	Contractor	Contractor	Contractor	-
2.	**Site Work and Services**				
2.1.	Site Development – General	Contractor	Contractor	Contractor	-
2.2.	Site Clearing	Contractor	Contractor	Contractor	-
2.3.	Site Storm Water and Erosion Control	Contractor	Contractor	Contractor	-
2.4.	Site Restoration	Contractor	Contractor	Contractor	-
2.5.	Roads and Work Pads	Contractor	Contracto	Contractor	-
2.6.	Environmental Control Plan	Contractor	Contractor	Contractor	-
2.7.	Construction Power	Contractor	Contractor	Contractor	Contractor
2.8.	Construction Support Facilities	Contractor	Contractor	Contractor	Contractor
2.9.	Construction Security	Contractor	Contractor	Contractor	Contractor
3.	**Engineering, Design, and Project Implementation Services**				
3.1.	Project Administration and Management	Contractor	Contractor	Contractor	Contractor
3.2.	Project Equipment and Material Management	Contractor	Contractor	Contractor	Contractor
3.3.	Site Management	Contractor	Contractor	Contractor	Contractor
3.4.	Procurement	Contractor	Contractor	-	-
3.5.	Construction and Contractor permits	Contractor	Contractor	Contractor	-
3.6.	Owner Permits	Owner	Owner	Contractor	-
3.7.	Landowner Coordination	Owner	Owner	Owner	
3.8.	Onsite Utility Owner Coordination	Contractor	Contractor	Contractor	-
3.9.	Contractor Proposed Schedule and List of Submittals for Each of the Preliminary and Final Design Submittal Phases	Contractor	Contractor	Contractor	-
3.10.	Engineering and Design of the Complete Project Including As-Builts	Contractor	Contractor	Contractor	Contractor
3.11.	Project Document Preparation and Submittal	Contractor	Contractor	Contractor	-

Item No.	Description	Engineer and Design and Technical Selection	Procure and Supply	Construct, Install, and Implement	Commission, Startup, and Test
3.12.	Electrical Studies – Including Arch Flash Study	Contractor	Contractor	Contractor	As Applicable
3.13.	Fire Protection and Detection Studies and Design (External to Battery Enclosures)	Contractor	Contractor	Contractor	As Applicable
3.14.	North American Electric Reliability Corporation (NERC) Compliance and Reports	Contractor	Contractor	Contractor	As Applicable
3.15.	Geotechnical Engineering Investigation Report	Owner	Owner	Owner	-
3.16.	Surface Survey Reports	Owner	Owner	Owner	-
3.17.	Quality Program	Contractor	Contractor	Contractor	-
3.18.	Operation and Maintenance Manuals	Contractor	Contractor	Contractor	-
3.19.	Training	Contractor	Contractor	Contractor	-
3.20.	Start-up and Commissioning (SU&C) and Testing Program	Contractor	Contractor	Contractor	Contractor
3.21.	Coordinate the Interconnection and Back Feed Power from the Transmission System	Contractor	Contractor	Contractor	Contractor
3.22.	Job Books and Project Turnover Package	Contractor	Contractor	Contractor	Contractor

Table 2-2. Owner Supplied Equipment

Not applicable. Contractor shall furnish all equipment for the project.

3.0 PROJECT DESIGN CRITERIA

3.1 General Requirements

3.1.1 This Section specifies the requirements for a fully functioning BESS that meets or exceeds all requirements delineated herein.

3.1.2 The Contractor shall be responsible for all aspects of a turn-key project; design, procurement, delivery, construction (including wiring, grounding, and communications), commissioning, and providing a complete cost estimate for the ongoing maintenance of a BESS for the life of the Project. This specification defines a factory-built, fully functioning BESS with batteries, power conversion system (PCS), enclosure(s), BESS switchgear, battery management system (BMS), EMS, fire detection and suppression system, environmental systems, protection and control system, internal wiring, communication and software, and all required programming for integration with Owner's existing SCADA system. Owner shall provide oversight during the engineering, procurement, and construction (EPC) process. Without limiting the foregoing, the following shall be the responsibility of the Contractor.

3.1.3 The Project shall be designed for a minimum life of 20 years. The Project shall maintain BESS nameplate output power and duration over the entire 20-year period.

3.1.4 The systems and equipment supplied by Contractor shall be suitable for the environment in which they will be located.

3.1.5 The specifications provided herein are intended to identify overall system requirements and certain specific hardware requirements to ensure the Project provided by Contractor shall operate reliably and safely during the Project's design life, and the Project shall operate and be maintained in a cost-effective manner. The adequacy of the overall system design to meet these requirements is the responsibility of Contractor.

3.1.6 The general system performance criteria are defined in this Scope of Work and its referenced attachments and exhibits. Contractor is responsible for ensuring all system performance criteria included in this specification are met by the final Project design.

3.1.7 Design and implementation of the Project shall comply with all interconnection requirements in the GIA.

3.1.8 Project design and implementation shall incorporate performance and adherence to all studies and system design required to ensure the transmission system interconnecting with the Project is capable of receiving the full Project output.

3.1.9 Supplemental site design criteria are provided in Exhibit F attachments.

3.1.10 The Contractor shall provide all reports and documentation for compliance with applicable NERC reliability standards.

3.2 Abbreviations and Acronyms

3.2.1

Table 3-1. Abbreviations and Acronyms

Acronym or Abbreviation	Term
AC	Alternating current
ACI	American Concrete Institute
AHJ	Authorities having jurisdiction
ALTA	American Land Title Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BESS	Battery energy storage system
BMP	Best management practice
BMS	Battery management system
COD	Commercial operation date
DC	Direct current
DIR	Dispatchable Intermittent Resource
DOD	Depth of discharge
DOT	Department of Transportation
EMS	Energy management system
EPC	Engineering, procurement, and construction
EURT	Equivalent Uniform Radial Thickness
Facility	Petersburg Generating Station
FAT	Factory acceptance test
GIA	Generator Interconnection Agreement
GSL	Ground snow load
HVAC	Heating, ventilating, and air conditioning

Acronym or Abbreviation	Term
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
ITP	Inspection and test plan
kV	Kilovolt
LV	Low voltage
MISO	Midcontinent Independent System Operator
mph	Miles per hour
MTBF	Mean time between failure
MV	Medium voltage
MVA	Megavolt ampere
MW	Megawatt
MWh	Megawatt hour
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NFPA	National Fire Protection Agency
O&M	Operations and maintenance
OEM	Original equipment manufacturer
OSHA	Occupational Safety and Health Administration
Owner	AES Indiana
PCS	Power conversion system
POI	Point of interconnect
Project	Petersburg BESS Project
PVC	Polyvinyl chloride
SCADA	Supervisory control and data acquisition
SDS	Safety data sheet
SOC	State of charge
SPCC	Spill Prevention Countermeasures and Control
SWMP	Storm Water Management Plan
SWPPP	Storm Water Pollution Prevention Plan
UL	Underwriters Laboratories

3.3 Site Location

3.3.1 The Project will be located on a greenfield site. See Exhibit F – Attachment 1 for the preliminary site layout of the Project.

3.4 Boundary and Interface Limits

3.4.1 Contractor's work shall be on lands under control by Owner. Initial project limits are shown on drawings in Exhibit F - Attachment 1 to the EPC Agreement. Contractor shall confirm the project limits with Owner prior to the start of services under this Agreement.

3.4.2 Owner has procured a quantity of land expected to be sufficient to support the final project design and layout as well as construction-related space requirements like laydown and parking.

3.4.2.1 If additional space is required to support construction activities, Contractor shall procure such land and include the cost for such additional land in its bid.

3.5 Site Design Data

3.5.1 Project shall be capable of continuous operation for the full range of "Ambient Operational Temperature Range" conditions at the respective project location and as shown in Table 3-1.

3.5.2 All equipment and materials shall be rated to withstand the full range of "Ambient Temperature Rating Range" conditions shown in Table 3-1.

3.5.3 All equipment heating and cooling systems, where required, shall be designed for the full "Ambient Temperature Rating Range" conditions and account for ambient conditions that will be experienced, such as direct sunlight exposure and windchill factored heat loss. Contractor shall maintain equipment within manufacturer's recommended conditions for operation, stand-by, and storage.

Table 3-2. Site Ambient Design Criteria

Project Bid Name	Reference		Design Conditions			
	Site Ambient Temperature Range [1]		Ambient Operating Temperature Range [2]		Ambient Temperature Rating Range [3]	
	Minimum (deg C)	Maximum (deg C)	Minimum (deg C)	Maximum (deg C)	Minimum (deg C)	Maximum (deg C)
Petersburg BESS, Petersburg Indiana (American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) weather station: Laurenceville Municipal)	-18.8 (annual)/ -25.8 (50-year event)	36.5 (annual)/ 42.1 (50-year event)	-25	40	-40	60

[1] – Based on ASHRAE climatic data – Extreme Annual Mean Database and 50-Year Extreme Database Temperatures.

[2] – Equipment, components, and materials can withstand this range while operating at nameplate capacity without accelerating degradation of equipment beyond design rate or suffering damage or degradation to performance so repair or replacement is required to restore performance. Range based on typical equipment operating range capabilities. Where discrepancies between this table and any other specified temperatures exist, the more stringent requirement shall apply.

[3] – Equipment, components, and materials can withstand this range while not in operation, or at reduced operational performance, without suffering damage or degradation to performance so repair or replacement is required to restore performance. Range based on ASHRAE climatic data: 50-year extreme temperature (absolute value +3 °F) or typical equipment operating range of -13 °F to 104 °F, whichever is more extreme. Where discrepancies between this table and any other specified temperatures exist, the more stringent requirement shall apply.

Table 3-3. Site Loading Design Criteria

Project Bid Name	Design Condition				
	Wind	Seismic [1]	Snow	Ice	Frost
	- 3 Sec Gust - Exposure Category	- Soil Class - Spectral Accelerations (SS/S1) - Importance Factor	- Ground Snow Load (GSL) - Importance Factor	- Equivalent Uniform Radial Thickness (EURT) - Importance Factor	- Frost/Adfreeze
Petersburg BESS, Petersburg Indiana	• 100 miles per hour (mph) • Category I	• Soil Class C • SS=0.421/S1=0.148 • Ie= 1.0	• GSL= 20 lb/sq ft • Is= 0.80	EURT = 1.5 inches Ii = 0.80	[2]

[1] - Seismic design criteria are currently based on American Society of Civil Engineers (ASCE) 7, these values shall be adjusted by the Contractor based on Owner's geotechnical investigation and report, see section 7.1.4.

[2] - Contractor shall determine frost and adfreeze depths based on recommendations of geotechnical study and geotechnical engineer's recommendations to account for frost jacking and adfreeze design pressures and forces in the design.

3.6 Operational Criteria

3.6.1 The Project shall be designed for fully automatic, unmanned operation. This shall include startup, shutdown, protection against abnormal operating conditions (i.e., voltage, frequency excursions), etc. Transmission interconnection shall meet all requirements of transmission owner interconnect requirements as well as applicable MISO Dispatchable Intermittent Resource (DIR) requirements and NERC requirements at project commercial operation date (COD).

3.7 Reliability and Maintainability

3.7.1 Reliability and availability of the Project are prime requirements of the Project. Project design philosophy shall be used to attain high reliability, providing no less than a 99% availability rate.

3.7.2 Project design philosophy and equipment and material selections shall provide a dependable, reliable, and durable final installation that reduces ongoing maintenance, extends equipment mean time between failure (MTBF) and equipment life. Contractor shall utilize the project design and equipment and material selections activities as tools to attain maintainability, at minimum, which is consistent with industry standards. Design features that offer long-term operations and maintenance (O&M) cost reductions shall be offered, specifically those that in the Contractor's experience offer beneficial value to cost ratios.

3.7.3 Project design and equipment and material selections shall be based on proven design concepts, which have been utilized successfully and met performance expectations under commercial operation for similar applications.

3.7.4 Contractor shall provide an all-inclusive O&M manual, which is the typical daily, monthly, and annual maintenance activities list for the expected long-term operation of the Project. This shall include inspection and testing activities, preventative and periodic maintenance activities, and recommended equipment replacement intervals for the Project; these listed activities shall be inclusive of the recommended and required activities provided in the International Electrical Testing Association Maintenance Testing Specification. The Contractor shall provide a catalog listing the names, part numbers, typical lead times and other identification and planning information for all unique components (Asset Register) requiring preventative maintenance.

3.7.5 Based on requirements of Exhibit F – Attachement 2 an augmentation plan may be required to maintain nameplate rating throughout Project lifetime. Contractor shall provide augmentation plan, schedule, and manual associated with any proposed augmentation.

3.8 Miscellaneous Technical Requirements

3.8.1 Contractor shall acquaint itself with the Project Site and applicable permit conditions and design the balance of system to be suitable for the site environmental conditions, including elevation, temperatures, corrosion potential, etc.

3.8.1.1 The Contractor shall be responsible for coordinating with all utility owners whose facilities pass through the site, above or below grade, to determine all aspects of the Project that will be impacted by the utility and to provide a compliant design and final installation. Such factors may include road crossings, collector line crossings, and easement and setback requirements for any work and permanently installed portions of the Project.

3.8.2 The Project shall meet all applicable federal, state, and local noise requirements.

3.8.3 If the noise level is above OSHA linear field threshold, then appropriate signage shall be installed.

3.8.4 The Contractor shall be responsible for providing signs for high noise areas requiring hearing protection, arc flash hazards, and other items needed to meet OSHA regulations and otherwise ensure minimal risk to personnel health and safety while at the Project.

3.8.5 Arrangements shall provide a minimum vertical clearance of 18 feet at all roads under any structures, wires, and equipment, platforms and pipe bridges, etc. Where code requirements call for additional overhead clearance, this additional clearance shall be provided.

3.8.6 The Contractor shall provide the equipment naming convention to Owner for approval. Owner shall have final approval rights to the naming convention used.

3.8.7 All equipment shall be provided with permanent engraved labels.

3.9 Codes, Regulations, and Standards

3.9.1 Contractor shall design the Project in accordance with all applicable federal, state, and local laws and codes, regulations, and standards, including those listed below. The codes and standards utilized shall be the latest editions in effect on the effective date of this Agreement. Where these codes do not govern specific features of the equipment or system, Contractor and original equipment manufacturer (OEM) standards shall be applied. Where local codes or ordinances will have an impact on the design (e.g., building height restrictions) or equipment selection, Contractor shall jointly address these with the local authorities having jurisdiction (AHJ). Contractor shall review all applicable laws, codes, and standards throughout the Project duration. Any change in requirements, which become applicable to the Work prior to final turnover, shall be identified and presented to Owner with recommended implementation options for Owner's consideration and final approval.

3.9.2 Federal regulations

3.9.2.1 US Environmental Protection Agency

3.9.2.1.1 Resource Conservation and Recovery Act

3.9.2.1.2 Clean Water Act

3.9.2.1.3 Clean Air Act

3.9.2.1.4 Oil Pollution Act

3.9.2.1.5 Comprehensive Environmental Response, Compensation and Liability Act

3.9.2.1.6 Emergency Planning and Right-to-Know Act

3.9.2.1.7 Toxic Substances Control Act

3.9.2.2 National Environmental Policy Act

3.9.2.3 US Fish and Wildlife (e.g., Endangered Species Act)

3.9.2.4 US Army Corps of Engineers

3.9.2.5 OSHA

3.9.2.5.1 29 Code of Federal Regulations (CFR) 1910 Occupational Safety and Health Standards

3.9.2.5.2 29 CFR 1926 Safety and Health Regulations for Construction

3.9.2.6 US Department of Transportation (DOT)

3.9.2.7 CFR

3.9.3 Applicable state, county, and local codes and regulations

3.9.3.1 County

3.9.3.2 DOT

3.9.3.3 Local Codes and Ordinances

3.9.4 Applicable industry codes and standards from the following list as applicable for a utility scale BESS plant. Alternative standards may be used with written justification on how compliance is achieved

3.9.4.1 Mechanical

3.9.4.1.1 American National Standards Institute (ANSI)

3.9.4.1.2 Power Test Codes - Applicable Test Codes

3.9.4.1.3 American Society for Nondestructive Testing

3.9.4.1.4 American Society for Testing and Materials (ASTM)

3.9.4.1.5 American Welding Society

3.9.4.1.6 Steel Structures Painting Council

3.9.4.1.7 Manufacturers Standardization Society

3.9.4.2 Electrical

3.9.4.2.1 ANSI

3.9.4.2.2 Factory Mutual

3.9.4.2.3 Insulated Cable Engineers Association (ICEA)

3.9.4.2.4 Institute of Electrical and Electronics Engineers (IEEE)

3.9.4.2.5 Illuminating Engineering Society of North America

3.9.4.2.6 International Society for Measurement and Control

3.9.4.2.7 NEC, latest version adopted by AHJ

3.9.4.2.8 National Electrical Manufacturers Association (NEMA)

3.9.4.2.9 National Electrical Safety Code (NESC)

3.9.4.2.10 Underwriters Laboratories (UL)

3.9.4.2.11 National Fire Protection Agency (NFPA)

3.9.4.2.12 International Electric Code

3.9.4.2.13 Other local codes as required

3.9.4.3 Civil, Structural, and Architectural

3.9.4.3.1 American Concrete Institute (ACI)

A. ACI 318 - Building Code Requirements for Reinforced Concrete

B. ACI Manual of Standard Practice

C. ACI 350R – Environmental Engineering Concrete Structures

3.9.4.3.2 ASCE 7 – Minimum Design Loads for Buildings and Other Structures

3.9.4.3.3 American Institute of Steel Construction

3.9.4.3.4 American Iron and Steel Institute "Specification for Design of Cold-Formed Steel Structural Members," Parts 1 and 2

3.9.4.3.5 American Welding Society

3.9.4.3.6 State building code and any state and local amendments and codes. In the absence of a defined local building code or regulation, the latest version of the International Code Council codes shall be used as the basis of design (e.g., 2018 International Building Code).

3.9.4.3.7 Steel Structures Painting Council

3.9.5 BESS Reference Standards

3.9.5.1 IEEE

3.9.5.1.1 519 - Recommended Practice and Requirements for Harmonic Control in Electronic Power Systems

3.9.5.1.2 1547 - Standard for Interconnecting Distributed Resources with Electric Power Systems

3.9.5.1.3 2030.2 -Interoperability of Energy Storage Systems Integrated with the Electric Power Infrastructure

3.9.5.2 NFPA

3.9.5.2.1 70 - NEC

3.9.5.2.2 855 - Standard for the Installation of Stationary Energy Storage Systems

3.9.5.3 UL

3.9.5.3.1 508C - General safety for power conversion equipment

3.9.5.3.2 1642 - Standard for Lithium Batteries

3.9.5.3.3 1741 - Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources

3.9.5.3.4 1973 - Standard for Batteries for Use in Stationary Vehicle and Light Electric Rail Applications

3.9.5.3.5 9540 - Standard for Energy Storage Systems and Equipment

3.9.5.4 NESC (latest adopted edition)

3.9.6 In the case of a conflict or contradiction brought up by any discrepancy between local and international or US codes, the more stringent code shall take precedent

4.0 BATTERY ENERGY STORAGE SYSTEM

4.1 Project Performance Requirements

4.1.1 Contractor shall provide a performance guarantee that ensures the BESS operates as required throughout the lifespan of the Project. The primary performance requirement is that the Project must be capable of operating safely, reliably, and continuously at all ranges of power output and ambient conditions.

4.1.2 The BESS Project shall meet minimum lifespan given the stated duty cycle herein. If this requirement cannot be satisfied, Contractor shall identify the achievable lifespan for the technology offered.

4.1.3 The BESS nameplate energy capacity will be expected to be maintained throughout the Project's lifespan. The Contractor shall provide a description of the proposed methodology to maintain the system capacity and shall provide estimated O&M costs to maintain this capacity.

4.1.4 Sufficient state of charge (SOC) and limits on DOD must be maintained to meet the requirements of this specification. Contractor shall determine appropriate SOC and DOD to meet this requirement.

4.1.5 Battery management systems, individual cells, or cell modules shall be designed for isolation, testing, diagnostic monitoring, and removal without interruption of BESS availability to the grid.

4.1.6 The BESS shall also meet the following requirements:

4.1.6.1 Meets or exceeds the recommended performance specifications defined in Appendix A of the September 2018 NERC Reliability Guideline for Bulk Power System-Connected, Inverter-Based Resource Performance at the Point of Delivery.

4.2 Battery Enclosure

4.2.1 The BESS shall be installed in a series of climate-controlled enclosures that meet all requirements of the battery manufacturer for maintaining and optimizing the BESS performance, reliability, and longevity.

4.2.2 BESS enclosure fire protection shall be in accordance with the requirements provided in Exhibit F – Scope of Work Section 6.2 and AES Reference 4 Fire and Life Safety Requirements.

4.2.3 The BESS enclosure(s) shall be supplied with a heating, ventilation, and air conditioning (HVAC) system or other climate control system of adequate size for heating, cooling, and ventilating the BESS systems and maintaining the BESS within safe operating temperatures and humidity levels in accordance with the operating parameters of the battery modules. Climate control system design shall account for site ambient conditions, direct sunlight exposure, direct precipitation, and wind exposure.

4.2.4 General electrical requirements beyond those described herein shall be in accordance with Exhibit F – Scope of Work Section 5.0. BESS auxiliary loads shall be supplied from an auxiliary power system and metered separately from the charge and discharge path.

4.2.5 As applicable, the BMS shall provide for thermal derating of the BESS to ensure battery life is not adversely affected by ambient temperature inside the individual battery enclosures.

4.2.6 End of Life

4.2.6.1 At the termination of the Project's useable life, the BESS equipment supplier shall be responsible for decommissioning, removal, and recycling of all expended battery cells.

4.2.6.2 The BESS equipment supplier shall provide a decommissioning and recycling plan for the expended battery cells.

4.3 Power Conversion System

4.3.1 Contractor shall supply multiple PCS units to provide for charging and discharging of individual battery enclosures or groups of multiple enclosures.

4.3.2 The PCS shall be responsible for voltage control and reactive power control in accordance with the technical specifications of this Project.

4.3.3 Contractor shall supply a four-quadrant PCS compliant with UL 1741A and IEEE 2800, allowing for extended high and low voltage (LV) ride through, active power control, reactive power control, dynamic active power support under abnormal frequency conditions, dynamic voltage support under abnormal voltage conditions, power quality, negative sequence current injection, and system protection.

4.3.4 The ramp rate of charging and discharging of the BESS shall be programmable or set to a defined value by manually entering a value into the BESS human-machine interface or by the Owner's SCADA control system.

4.3.5 The power quality to the grid shall meet the harmonic requirements as indicated in IEEE 519.

4.3.6 Disconnect switches shall be installed so personnel can locally and manually isolate the battery from the PCS (DC switch) and locally and manually isolate the PCS from the medium-voltage feeder circuit (AC switch). These disconnect switches shall be gang-operated, lockable in the open position, and have a visible break.

4.3.7 The PCS shall have the ability to withstand an asynchronous connection to the grid.

4.3.8 The PCS must meet the requirements of the Interconnection Agreement.

4.4 PCS Enclosure

4.4.1 The PCS shall be installed in a climate-controlled, weather-proof enclosure that should meet the Project duration given all environmental conditions.

4.4.2 Enclosure requirements shall follow those as defined for the BESS enclosure herein.

4.5 INSTRUMENTATION AND CONTROL

4.5.1 General

4.5.1.1 Instrumentation and control equipment for all systems shall be Contractor-furnished in accordance with the requirements defined herein.

4.5.2 EMS

4.5.2.1 The BESS EMS shall be designed to provide for automatic, unattended operation of the BESS. The EMS design shall also provide for local manual operation, remote operation, or dispatch of the BESS from the Owner's SCADA system or remote access point.

4.5.2.2 The BESS EMS shall provide all modes of operation suited to the applicable use cases described herein, and its operational set-point functionality shall have the ability to be prioritized and remotely configured through the Owner's SCADA system.

4.5.2.3 The EMS shall provide available energy forecasting to the SCADA system, including any thermal derate.

4.5.2.4 The ramp rate of charging and discharging of the BESS shall be programmable or set to a defined value by manually or remotely entering a value into the BESS operator station or by the Owner's SCADA system communicating a ramp rate set point.

4.5.3 Supervisory Monitoring

4.5.3.1 Supervisory instrumentation shall be included for data monitoring, alarming, and protective functions in the control system. The following shall be included as a minimum:

4.5.3.1.1 Power factor

4.5.3.1.2 AC voltage

4.5.3.1.3 DC voltage

4.5.3.1.4 AC current

4.5.3.1.5 DC current

4.5.3.1.6 Kilowatt

4.5.3.1.7 Kilovolt-amp

4.5.3.1.8 Kilovolt-amp reactive

4.5.3.1.9 Kilowatt-hour available

4.5.3.1.10 Battery SOC

4.5.3.1.11 Inverters, including capture of all diagnostic information including:

- Temperatures
- Alarms
- Status indicators
- Fault states

4.5.3.1.12 Historian function with up to 60 days of storage of all data points with a resolution of one second

4.5.3.1.13 Sequence of events recorder for all protective functions with one millisecond resolution

4.5.4 BESS Workstations

4.5.4.1 A remote workstation shall be provided and located in the site control house to allow for operation and modification and creation of control logic, design and development of graphic displays, setting of alarm and control set points, and any other functions required for operating and maintaining the BESS. The remote workstation shall be equipped with a 24-inch, dual screen LED display.

4.5.5 Intrasite communications

4.5.5.1 The intrasite BESS communications system shall support BESS control commands, BESS data and alarms, alarm acknowledgement, logical events, and sequence of events which are recorded.

4.5.5.2 The intrasite BESS communications system be Ethernet Modbus or Owner approved alternate.

4.5.5.3 The intrasite BESS communications system shall designed to interface with new AES Indiana substation SCADA network within substation control house.

4.5.5.4 The intrasite BESS communications system shall interface with BESS EMS, BMS, and PCS and other control systems, as necessary.

5.0 ELECTRICAL

5.1.1 Protection

5.1.1.1 Inter-tie protection shall be provided by a Schweitzer Engineering Laboratories mircroprocessor relay or an equivalent approved by the Owner. Any other protective relays shall be microprocessor-based digital type. Protective relays shall be time synchronized to the sequence of event recorders and digital fault recorders by the use of a dedicated system master clock.

5.1.2 Revenue Energy Metering

5.1.2.1 Charging and discharge energy exchanged between the BESS and the grid shall include dedicated bi-directional electrical revenue metering.

5.1.3 Transformers

5.1.3.1 In addition to the requirements of Section 8.12, step-up transformers shall be pad-mounted, loop-fed, and designed to meet all requirements of the connected PCS, including grounded electrostatic shield and pulse withstand.

5.1.3.2 Close-coupled PCS and transformer combined skids are acceptable.

5.1.4 Switchgear

5.1.4.1 Switchgear dedicated to the BESS shall be provided in accordance with Section 8.13.

5.1.5 Raceway

5.1.5.1 Dedicated raceway systems shall be established for DC power in addition to the systems identified in Section 8.5.

5.1.6 Cable

5.1.6.1 Cables shall be in accordance with Section 8.6, Section 8.7 and Section 8.8.

5.1.7 Grounding

5.1.7.1 The DC and AC systems shall be grounded at the PCS at a common location with a buried ground ring about the equipment. The ground ring shall consist of bare copper conductors buried one meter deep, with copper (four) ground rods – one on each corner of the ring. The grounding system shall be interconnected to adjacent inverters and the point of interconnection with a bare grounding conductor following the medium voltage (MV) circuit as well as in accordance with Section 8.16.

5.1.7.2 Each PCS shall have a readily accessible ground ring test point for ongoing maintenance.

6.0 MECHANICAL SYSTEMS AND EQUIPMENT

6.1 GENERAL UTILITIES

6.1.1 Contractor shall supply and install all process and potable water, compressed and dried air, and HVAC and other utilities as required to support its design and equipment.

6.2 FIRE PROTECTION SYSTEM

6.2.1 The BESS enclosures shall be provided with dedicated fire protection systems consisting of detection, automatic solid aerosol suppression, carbon monoxide gas detection, and deflagration venting. The BESS fire protection system shall be designed and constructed in accordance with the AES BESS Fire Protection Guidance Document, Revision 3.

6.2.2 All fire protection materials or services that require approval in accordance with the applicable local or national codes and standards for fire protection shall be factory manual or UL approved.

6.2.3 The AHJ shall be the local fire marshal or equivalent. Contractor shall be responsible for contacting the AHJ and determining if any local codes or rules apply to the Project.

6.2.4 All applicable recommendations of the applicable local or national code for fire prevention and fire protection for electric generating plants and high voltage DC converter stations shall be used. If no applicable code is available, then NFPA 850 shall be considered as required in the design of the Project. All applicable requirements of NFPA 855 shall be considered as required in the design of the BESS enclosure fire detection and suppression.

6.2.5 Contractor shall prepare a fire protection design basis document and submit to Owner. The approved design basis document shall be periodically updated during the design phase of the Project and resubmitted to Owner.

6.2.6 Fire Alarm and Detection

6.2.6.1 A fire alarm and detection system shall be provided. The fire alarm system shall include a Very Early Smoke Detection Apparatus system and smoke detection. The BESS fire alarm system shall be monitored by a remote AES facility that is UL-listed.

6.2.6.2 Alarm control panels in the remote AES facility shall accept signals from the detecting devices in the BESS facility and alarm in the remote AES facility and initiate release of the BESS fire suppression system. Local alarms and indication shall also be provided.

6.2.6.3 A proprietary fire alarm system shall be provided for the Project with local structure fire alarms and automatic fire detectors.

6.2.6.4 Aspirating smoke detectors for electronics and electrical rooms shall take samples from each electrical room to allow alarm indication down to the individual room level.

6.2.7 Fire Water Supply

6.2.7.1 The Project fire water supply shall be derived by the Contractor.

6.2.7.2 Fire hydrants are placed around the site to provide coverage of the BESS and the transformers.

6.2.7.3 The table below outlines the minimum fire detection and suppression systems to be provided for the Project's buildings, structures, and equipment.

Table 6-1. Minimum Fire Detection and Suppression Systems

Area or Equipment	Suppression System	Detection	Actuation
BESS Cabinets	Per NFPA 855 for specific battery chemistry	Per NFPA 855 for specific battery chemistry	Automatic – Contractor to provide complete details with proposal
Oil-Filled Transformers	Fire walls or spatial separation	None	None

6.3 Owner Specific Requirements

6.3.1 AES Indiana BESS fire protection requirements are outlined in AES Reference #4 – Fire and Life Safety Requirements.

6.3.2 In the case of a conflict or contradiction brought up by any discrepancy between Section 6.2 – Fire Protection System and AES Reference #4 – Fire and Life Safety Requirements, AES Indiana fire protection guidelines will take precedence.

7.0 CIVIL AND STRUCTURAL FEATURES

7.1 Civil and Structural Design Basis

7.1.1 The following preliminary documents are provided for information only. The design for new facilities shall be based on final investigations and surveys as defined below. Any additional investigation or survey work that Contractor requires or desires to complete its work shall be the responsibility of the Contractor.

Table 7-1. Preliminary Documents for Structural Design Basis

Design Basis Document	Preliminary		Final	
	Provided By	Exhibit F Location	Provided By	Exhibit F Location
Site Plan	Owner	Attachment 1	Contractor	Contract deliverable
Site Topological Survey	Owner	AES Reference #5	Not required,	N/A

Design Basis Document	Preliminary		Final	
	Provided By	Exhibit F Location	Provided By	Exhibit F Location
			optional (up to EPC)	
Site American Land Title Association (ALTA) Survey	Owner	(Future)	N/A	N/A
Site Geotechnical Investigation	Owner	AES Reference #1	Not required, optional (up to EPC)	N/A

7.1.2 Surface Surveys and Investigations

7.1.2.1 The Contractor shall be solely responsible for furnishing all labor, materials, tools, and equipment to perform all surveying work (inclusive of final topographic and ALTA surveys) and geotechnical investigations as determined necessary by Contractor. The Contractor shall provide all services necessary for, or incidental to construction of the Project, and to establish and maintain benchmarks, to make measurements to verify location of completed construction, and to survey alignment to existing property boundaries. Underground utilities and surface penetrations shall be identified on the Contractor's drawings.

7.1.3 Easement and Setbacks

7.1.3.1 The Contractor shall observe all easements and setbacks described herein and in Exhibit F – Attachment 1 as reference. Final easements shall be identified on the site plan drawings to be developed by the Contractor during design. Minimum setback requirements shall be in accordance with local zoning codes and ordinances and the Contract requirements.

7.1.4 Geotechnical Investigation

7.1.4.1 Contractor shall provide the following services in regard to geotechnical investigations, studies, analysis, and associated engineering.

7.1.4.1.1 Review available geotechnical and geological data related to the project and available from the Owner's preliminary and final geotechnical investigation documentation.

7.1.4.1.2 Contractor shall determine excavation and backfill requirements for site structures, such as inverter stations. These shall be designed by a civil engineer and in conformance with the recommendations of the AES Reference #1 Geotechnical Engineering Report. Where compaction cannot be achieved by mechanical methods, controlled low-strength material shall be used for backfill.

7.1.4.1.3 Contractor shall determine excavation and backfill requirements for site utility trenching, including electrical trenches. These shall be designed by a civil engineer and in conformance with the recommendations of the AES Reference #1 Geotechnical Engineering Report. Perform quality assurance testing in conformance with the recommendations of the Geotechnical Engineering Report. At a minimum, perform one compaction test per lift at all locations where utility trenches cross a roadway.

7.2 Site Development

7.2.1 General

7.2.1.1 The Project design shall take into account existing site conditions with respect to site undergrounds and utilities, soil characteristics, site clearing, grading, and drainage. Contractor shall be responsible for all needed site preparation and soil stabilization. In addition to the site development work required to support Project construction, overall Project Site development shall also include permanent grading, drainage, roadways, and fencing and gate systems.

7.2.1.2 The site grading must be designed for a balanced site so the amount of fill equals the amount of material excavated.

7.2.1.3 All graded slopes must be 3:1 or flatter to allow mowing of the site. In areas that must be steeper and cannot be mowed, proper measures must be taken to minimize weed growth in an effort to reduce the need for string trimming and/or the use of herbicides.

7.2.1.4 Site elevation shall be established during the design process. Grading around foundations and exposed concrete slabs shall be sloped to assure proper drainage away from foundation structures.

7.2.1.5 Site grading shall be compatible with the general topography and uses of adjacent properties, right-of-way, set back, and easements.

7.2.1.6 Contractor will be responsible for preparing, submitting, and securing of all required construction-related permits including dewatering, demolition, clearing, burning, or other permits. Contractor will also be required to prepare and submit any and all site compliance certifications regarding work completion to applicable agencies (e.g., as-built certification of storm water management system, if required).

7.2.2 Site Clearing

7.2.2.1 Contractor shall complete tree and stump removal, clearing and grubbing and removal from site as necessary, and demolition of any obstructions or facilities necessary for the Project.

7.2.2.2 All non-organic, construction-related debris and material removed shall become the immediate property of Contractor and shall be removed from the premises and disposed of by Contractor in accordance with permits and federal, state, and local regulations. Contractor shall minimize landfill waste by recycling materials where possible.

7.2.2.3 On-site open burning will not be permitted unless approved by appropriate local authorities.

7.2.3 Site Storm Water and Erosion Control Management

7.2.3.1 Contractor shall develop the Storm Water Pollution Prevention Plan (SWPPP). The Contractor shall obtain a construction National Pollutant Discharge Elimination System permit including Notice of Intent and Notice of Termination, perform all required periodic inspections, and maintain appropriate documentation for the entire site.

7.2.3.2 Soil erosion and sediment controls shall generally consist of control of runoff, vegetative stabilization, and sediment traps. All slopes, drainage ditches, and other exposed areas shall be stabilized by vegetation. Sediment traps, such as hay bales or synthetic filter fabric (silt fence), shall be installed at culvert inlets and at the top and toe of slopes. Contractor shall maintain erosion and sediment control systems and ensure compliance with the SWPPP throughout the construction phase of the Project.

7.2.3.3 Contractor is responsible for all penalties incurred as a result of not maintaining erosion and sediment control measures in accordance with the permits, federal, state, and local regulations. Contractor is responsible for all remediation measures and remediation costs incurred by not following and maintaining the erosion and sediment control measures.

7.2.3.4 Contractor shall develop the permanent site Storm Water Management Plan (SWMP) according to all applicable permits. Contractor shall implement all best management practices (BMPs) to provide Owner with a compliant site. Site grading, vegetation, and other BMP features shall be developed to minimize ongoing maintenance requirements for the Owner to maintain compliance with the SWMP. Contractors shall be responsible for final grading and soil and topsoil quality requirements to accommodate permanent re-establishment of site vegetation. Topsoil depth across the site at the completion of construction must match the existing topsoil depth identified in the geotechnical report.

7.2.3.5 Contractor shall perform all necessary hydrological and drainage studies to establish all required design related parameters related to storm water impacts, including flood depths. Water induation depths must be shown in the plan set for the pre-construction and post-construction conditions so the Contractor knows where not to store equipment overnight during construction and also for quick verification of where solar equipment maybe be subject to flooding and/or standing water.

7.2.3.6 Contractor's site grading and drainage system design shall assume any existing site drainage tile system is no longer functional due to damage from Contractor's installed piles and site work.

7.2.3.7 Contractor shall perform all needed construction phase and final site grading. This shall include excavating, demucking, backfilling, filling, and compacting of soils as required. Soils unsuitable for sub-grade shall be removed and replaced with suitable backfill material. Contractor shall account for frost and adfreeze in backfill material selection.

7.2.3.8 Contractor shall be responsible for installing and maintaining adequate drainage and preventing soil erosion at the site during construction in accordance with state and local sediment and erosion control rules, regulations, and ordinances.

7.2.3.9 Contractor shall be responsible for final site development, restoration, and establishment to maintain adequate drainage and prevent soil erosion during Project operation in accordance with state and local sediment and erosion control rules, regulations, and ordinances.

7.2.3.10 The drainage system may consist of storm water basins, berms, diversion berms, and outlet structures including rip rap. Design shall consider O&M ease of access and allow for mowing.

7.2.3.11 The drainage system shall be designed to comply with the 40 CFR 112 Spill Prevention Countermeasures and Control (SPCC) rule changes published in the Federal Register. The Contractor shall develop the Project operational SPCC Plan and assess if any secondary containment is required for oil storage or electrical equipment. The SPCC Plan shall be sealed by a professional engineer.

7.2.3.12 The drainage system shall be designed to a 100-year storm event for protection of equipment and scour analysis.

7.2.3.13 Contractor shall proactively identify location of any pre-existing agricultural drain-tile on the project site and modify as required to prevent the release of sediment at the discharge point. This shall include, as necessary, cutting and capping all site drainage tile discharge points or modification of all discharge points, as required to prevent release of sediment from the site.

7.2.4 Fire Water Retention

7.2.4.1 Civil design shall include fire water containment basin assuming 500 gallons per minute flow for two hours.

7.2.5 Site Restoration

7.2.5.1 All site development areas disturbed during construction, including lay down, temporary spoil pile area, parking, and temporary office trailers, etc. shall be restored and stabilized in accordance with post-construction storm water drainage requirements. All soil disposed on-site shall be leveled and seeded.

7.2.5.2 All areas must be free of depressions, ruts, holes, rills, rocks, stumps, logs, trash, nails, and other debris that pose hazards to completing mowing and maintenance operations. Mowing will be part of the longterm maintenance plan for the site and must have the ability to complete without potentially throwing projectiles into the air. All surfaces must also be graded smooth to prevent the bouncing of mowing equipment

7.2.5.3 Contractor shall thoroughly clean the areas of the Work, removing all accumulations of scraps, waste, oil, grease, weld spatter, insulation, paint, and other foreign substances in accordance with Prudent Industry Practices.

7.2.5.4 Contractor shall thoroughly clean the inside of equipment, modules, and equipment enclosures removing all accumulations of dust, scraps, waste, oil, grease, weld spatter, insulation, paint, and other foreign substances in accordance with Prudent Industry Practices.

7.2.5.5 Any permanent Project equipment or facility surfaces damaged as a result of Contractor's Work or by deposits of insulation, concrete, paint, weld metal, or other adhering materials shall be restored by Contractor.

7.2.6 Roads and Work Pads

7.2.6.1 Sufficient access roads for maintenance and equipment replacement shall be included in the overall Project design.

7.2.6.2 The Project shall include an interior road system that provides service truck and typical service vehicles and equipment access to each inverter station, the onsite substation, and the off-site and public road system.

7.2.6.3 Road system shall be designed, where practical, in a looped manner to provide access to equipment locations from two directions and avoid blocking maintenance access to equipment when roadway or underground work may be occurring. Every deadend radial road shall be provided with a turnaround sized for fire truck turning radius as required by code and/or local fire department.

7.2.6.4 Road Construction

7.2.6.4.1 Site entrance roads shall be constructed with aggregate road base material per DOT specifications. Entrance roads shall extend off the off-site and public road system for the required distance to allow tractor trailer vehicles to fully pull off the off-site and public roads and park prior to entering the project site entrance gate, including 100 feet past the gate. These areas will also incorporate either cement stabilization or geofabric into the road design. Roads constructed with stone shall use material in accordance with Indiana DOT specifications.

7.2.6.4.2 The continuous access road path from each of the project entrances to the Project substation shall be constructed with aggregate road base material per DOT specifications. These areas will also incorporate either cement stabilization or geofabric into the road design.

7.2.6.4.3 All other on-site roads shall be constructed of compacted soil and shall provide access to each inverter station and the existing off-site road system. Where the native compacted roads encounter a soft or low spot, fill shall be placed and compacted. Roads shall be designed to avoid continual O&M maintenance of importing material.

7.2.6.5 The intersection radius, as measured from the edge of pavement, shall not be less than 35 feet.

7.2.6.6 Final road design shall be per Contractor's geotechnical investigation and geotechnical engineer's recommendations and requirements.

7.2.6.7 Roads may be constructed at grade to allow for existing drainage sheet-flow patterns to be consistent with pre-development discharge patterns, provided road construction is designed to withstand this sheet flow and prevent road erosion and washout. The maximum slope of roadways shall be five percent and the maximum cross slope shall be 2.5 percent. Channelization of water is to be avoided as much as possible. The use of side ditches along the roadway with culverts is to be avoided if at all possible; utilizing low-maintenance measures, such as properly designed low-water crossings, is preferred.

7.2.6.8 Culverts shall be included on site roads as needed to maintain drainage and prevent road washout. Culvert crossings (if any) shall be designed for a minimum of two American Association of State Highway and Transportation Officials HS-20 loading per day for Project operations. All culverts are required to have flared end sections to protect the culverts and reduce maintenance operations. Culverts must be installed in accordance with the manaufacturer's specifications.

7.2.6.9 Contractor shall design site roads to be able to service and/or replace equipment in future years. Contractor shall include AutoTURN requirements and an AutoTURN design sheet for each vehicle, similar to the 30% package. The crane and trailer shall be able to replace equipment including PCS and BESS equipment after completion of construction. Substation access roads shall be able to accommodate General Step-Up transformer replacement.

7.2.6.10 An unpaved perimeter path shall be provided adjacent to all fence lines for fence substation and BESS access and maintenance. Perimeter paths shall be a minimum of 24 feet wide with a two-foot shoulder and minimum centerline radii of 50 feet and meet other Project setback requirements.

7.2.6.11 Unpaved interior BESS unit access roads shall be a minimum of 14 feet wide with no shoulder and meet other Project equipment setback requirements.

7.2.6.12 A work pad shall be provided around each inverter station. The work pad will consist of a five-foot-wide flat surface around all sides of the inverter station. The work pad and transition slope shall be covered with a minimum of three inches of gravel. As required by site SPCC plan, the gravel shall be of sufficient volume to comply as passive secondary containment.

7.2.6.13 Structural fill shall be compacted to a minimum of 95 percent of the Modified Proctor maximum dry density in accordance with ASTM D 1557. General backfill shall be compacted to at least 90 percent of Modified Proctor. The backfill and compaction requirements identified as part of the geotechnical evaluation shall be incorporated, as appropriate.

7.2.7 Fencing and Gates

7.2.7.1 The Project site, including each site area separated by public roadways or site discontinuities, shall be completely enclosed with a perimeter security fence. The site fence shall be an eight-foot-tall deer fence. The fence shall be designed for a minimum 20-year life with minimal maintenance requirements. All entry gates shall be metal and meet the requirements provided in this section.

7.2.7.1.1 A minimum of one double-wide lockable, manual gate shall be placed at each Project entrance from a public roadway. Swing gates shall be internally braced against sagging and furnished with hinges, latches, stops, keepers, and locking mechanism.

7.2.7.1.2 Additional gates and types of gates, as required by Contractor's final layout to service operation, maintenance, and construction, shall be provided and installed by the Contractor.

7.2.7.1.3 Contractor shall provide grounding to fence based on findings from grounding study.

7.2.7.1.4 Contractor shall provide deer fencing mesh, line post, and corner post details with its proposal. Contractor must provide a fence detail at stream and/or ditch crossings where the potential for debris accumulation exists; the section must include a "flow-through" design that allows debris passage and prevents damage to the fence at such crossings.

7.2.7.1.5 All gate posts and corner posts (where the fence changes direction by minimum of 45 degrees) shall be set in concrete footings having a diameter at least three times the post diameter and a depth exceeding the design frost and adfreeze bond depths or a minimum of three feet below grade, whichever is greater.

7.2.7.2 If permitting requires, Contractor shall furnish and install a chain link fence that meets the above requirements as well as the additional requirements provided below for the site perimeter security fence.

7.2.7.2.1 Seven-foot-high chain link fence topped with one-foot barbed wire extension.

7.2.7.2.2 Provide 45-degree, one-piece, three-wire extension arms for barbed wire. Barbed wire shall be two-strand, 12.5 minimum W&M gauge wire with four-point barbs of 14-gauge wire at five-inch maximum spacing

7.2.7.2.3 Chain link fence fabric material shall consist of commercial grade two-inch mesh, No. 11 gauge galvanized steel.

7.2.7.2.4 Fence shall have top rail and bottom tension wire. Top rails shall be 1-5/8 inches outside diameter pipe minimum. Wire shall be No. 7 gauge galvanized steel.

7.2.7.2.5 Line posts shall be a minimum 1-7/8 inch (outside diameter) meeting the requirements of ASTM F1043 Group C. End posts shall be a minimum of 2-3/8 inches (outside diameter). End and corner posts shall be braced.

7.2.7.2.6 Contractor shall provide grounding to fence based on findings from grounding study.

7.2.7.3 Protective bollards shall be placed in all areas requiring protection from accidental contact by vehicles or equipment, where final design locations warrant them as needed.

7.3 Foundations

7.3.1 The foundation design shall be based on the recommendations presented in the final geotechnical report.

7.3.2 Foundations shall be reinforced concrete slab on grade or steel piles designed to support the imposed loads.

7.3.3 Inverter station foundations shall account for containment in accordance with the SPCC Plan containment requirements. If required at inverter stations, containment may be provided by foundation system, appropriate volume of surrounding rock, and/or integrated containment within the inverter station skid.

7.3.4 Type of foundations required and allowable bearing values for soil shall be confirmed or as recommended by the geotechnical engineer based on the existing subsurface conditions throughout the complete project site.

7.3.5 All foundation design shall be designed to prevent frost jacking due to the frost heave and adfreeze pressures.

7.3.6 Concrete

7.3.6.1 Reinforced concrete structures shall be designed in accordance with ACI 318, Building Code Requirements for Reinforced Concrete. Concrete work shall conform to the requirements of ACI 301, Specifications for Structural Concrete.

7.3.6.2 Concrete proportioning shall be in accordance with the applicable ACI standards and specifications. All concrete mixes shall be appropriate for the climate conditions at the project site and approved by the responsible design engineer.

7.3.6.3 Grout shall be pre-packaged, non-shrinking grout requiring water only, suitable for the service.

7.3.6.4 Reinforcing bars shall be deformed bars conforming to ASTM A615, Grade 60. Welded wire fabric shall conform to ASTM A185.

7.3.6.5 Cement shall be Portland cement conforming to ASTM C150, Type (as required by soil conditions).

7.3.6.6 Aggregates for normal weight concrete shall conform to ASTM C33.

8.0 ELECTRICAL SYSTEMS AND EQUIPMENT

8.1 General Requirements

8.1.1 The Project electrical systems and equipment shall be designed in conformance with the Project Electrical Studies section herein. Contractor shall perform all calculations necessary for proper sizing of electrical equipment and systems to ensure safe and reliable Project operation under all Project operating conditions and electrical transmission system conditions.

8.1.2 All electrical systems shall be designed to minimize the generation of harmonics and the effects of electrical interference between power and control and instrumentation circuits and comply with applicable standards, codes, and regulatory requirements governing electromagnetic compatibility. No equipment shall cause radio or television interference in excess of the limits specified in the applicable local or national standard, or IEEE Std. 519 if none are available.

8.1.3 Voltage insulation levels, equipment interrupting and continuous current capacities, circuit protection, and mechanical strengths shall be selected and coordinated in accordance with calculations and the recommendations of IEEE, ICEA, NEMA, ANSI, NEC, UL and NESC.

8.1.4 Contractor shall provide (and coordinate if necessary) temporary construction power feed and supply to site.

8.1.4.1 Defer to environmental standards for fuel storage requirements.

8.1.5 Contractor shall furnish all industry best practice labels (e.g., NEC-required labels, ANSI-approved arc flash labels warning of the dangers of arc flash). Such labels shall be supplied and affixed to any equipment that may require service or maintenance while energized, as specified in the Contractor-provided arc flash study.

8.1.6 Environmental Conditions

8.1.6.1 All battery enclosures, PCS stations, transformers, combiner boxes, and other electrical equipment shall be located a minimum of 12 inches above both the ponding elevation that results from a 100-year, 24-hour storm event and the 100-year floodplain elevation.

8.1.6.2 Conduit and cable tray entry to outdoor enclosures, panels, switchgear, cabinets, etc. shall not be from the top. Bottom entry is preferred for rain protection. If bottom entry is not practical and side entry is required, entrances shall be installed with watertight fittings. All fastening hardware for enclosures, panels, etc. shall use the manufacturer's recommended attachment locations, variations will require manufacturer's approval. Top entry will not be permitted.

8.1.6.3 Enclosures for all equipment shall be in accordance with NEMA Standards and type number and shall be suitable for their location as follows:

8.1.6.3.1	NEMA 1	Indoors (general purpose)
8.1.6.3.2	NEMA 3R	Outdoors and Indoors (in wet locations)
8.1.6.3.3	NEMA 4	Outdoors and Indoors (in wet locations – dust tight)
8.1.6.3.4	NEMA 4X	Outdoors and Indoors (in wet and corrosion resistant locations)
8.1.6.3.5	NEMA 7	Classified Areas, Class I, Division 1 Group D
8.1.6.3.6	NEMA 9	Classified Areas, Class II, Division 1

8.1.6.3.7 NEMA 12 Non-Environmentally Controlled Indoor Dusty Areas

8.1.6.3.8 Enclosures containing non-arching devices (sealed contacts, terminals, etc.) may be NEMA 12 or 4X in Class I, Division 2 areas as the installed location dictates.

8.1.6.4 Enclosures for all equipment, components, weatherheads and conduits shall be provided with seals that comply with NEMA 4X rating and designed to prevent intrusion of pests and other wildlife.

8.2 Owner Specific Requirements

8.2.1 BESS power plant to follow ICEA Method 1 Table E-1 color code method.

8.2.2 Emerson DCS is current plant SCADA provider.

8.2.3 Secondary containment is required on all transformers.

8.3 Interconnection Facilities

8.3.1 Collector substation may be independently contracted pending Owner's contracting strategy.

8.3.2 Interconnection with Owner's facilities will be contracted independently of BESS.

8.3.3 Interconnection applications included in AES Reference #2 and AES Reference #3.

8.3.4 Design and installation shall be NERC compliant.

8.4 Auxiliary Power Supply System

8.4.1 Contractor shall be responsible for design, procurement, installation, and testing of all necessary auxiliary transformers and other ancillary electrical equipment required for the Project.

8.4.2 Auxiliary power supply system shall be designed to meet electrical requirements of supplied battery enclosures, PCS units, and all associated equipment.

8.4.3 Auxiliary power supply system shall meet AHJ requirements including fire detection and suppression system requirements.

8.4.4 All auxiliary transformers or power distribution centers shall be evaluated and approved by Owner.

8.4.5 Auxiliary power supply system shall be operational prior to arrival of Contractor-supplied batteries to ensure site conditions will support auxiliary power to BESS HVAC system. If these conditions cannot be met, Contractor is responsible for providing necessary means of maintaining BESS HVAC system upon delivery.

8.4.6 Auxiliary power supply system shall have dedicated meter. Metering shall comply with NERC, MISO, and Owner requirements as applicable.

8.5 Raceway and Miscellaneous Services

8.5.1 Conduit and Cable Tray

8.5.1.1 All conduit shall be electrical grade, appropriately sized, and rated for the subject environment, and where exposed to sunlight rated for UV exposure.

8.5.1.2 Underground conduits shall be schedule 40 PVC direct buried rated. Transition to conduit is required at the elbow leading to above grade connections.

8.5.1.3 Aboveground conduit shall be 3/4-inch minimum except 1/2-inch conduit may be used to connect to instruments or devices with 1/2-inch nipples as required. Aboveground conduit shall be schedule 80 PVC – UV Resistant.

8.5.1.4 Conduit openings to be provided with seals designed to protect against intrusion of pests and other wildlife.

8.6 Power and Instrument Cable

8.6.1 All MV, LV, and DC cable calculation shall comply with latest NEC and Electrical Transient and Analysis Program (or equivalent) software based on the selected thermal Rho value, load factor, ambient soil temperature, number of parallel circuits in the trench or ductbank, and compaction rate as described in the geotechnical report. If the compaction rate cannot be achieved based on the geotechnical report, additional soil measurement and testing will be required for proper cable sizing.

8.6.2 Adequate physical separation shall be ensured between DC and AC power cables, control cables, and instrumentation cables to minimize the effects of mutual heating, electrical interference, and other disturbances. Cables associated with the data acquisition system shall be routed and isolated in accordance with system manufacturer's circuit separation criteria.

8.7 MV Cable

8.7.1 MV cable and terminations shall be in accordance with the below requirements:

8.7.1.1 Ratings

8.7.1.1.1 MV AC cable conductor sizes shall be determined from consideration of the maximum conductor temperatures under sustained and three phase short-circuit and ground fault conditions, disconnection time of the protection, and voltage regulation under steady state and motor starting conditions. MV AC cable sizing and spacing shall be determined based on the site Rho values and other parameters such as parallel circuits in the same trench, soil temperature, 20 to 30 °C, load factor of 75% and minimum burial depth in compliance with NEC as required by other site conditions, traffic, and loading at grade.

8.7.1.2 Standards

8.7.1.2.1 NEMA/ICEA WC 74/S-93-639

8.7.1.2.2 AEIC CS8

8.7.1.2.3 UL 1072

8.7.1.3 Conductor Material

8.7.1.3.1 As indicated on the drawings

8.7.1.3.2 Aluminum conductor shall be either three-quarter, hard drawn 1350-H16 or full hard drawn 1350-H19 compressed Class B stranded meeting the ASTM requirements shown in ANSI/ICEA S-94-649 latest revision.

8.7.1.3.3 Stranded aluminum conductors shall be blocked in accordance with ANSI/ICEA S-94-649 latest revision. There shall be no excess compound on the outside of the conductor.

8.7.1.3.4 Copper conductor shall be either annealed uncoated compressed or compact Class B stranded meeting the ASTM requirements shown in ANSI/ICEA S-94-649 latest revision.

8.7.1.3.5 Strand blocking compound shall not be applied to copper conductors.

8.7.1.3.6 The center strand of the conductor shall be indent printed as indicated in ANSI/ICEA S-94-649 latest revisions.

8.7.1.4 Strand-Fill

8.7.1.4.1 Cables shall have strand-fill to block moisture between conductor strands.

8.7.1.5 Insulation

8.7.1.5.1 Temperature rating: Type MV-90 per NFPA 70.

8.7.1.5.2 EPR or TR-cross-linked polyethylene (XLPE) or as shown on the drawings.

8.7.1.5.3 100% insulation level. 133% is also acceptable.

8.7.1.5.4 The shields and insulation shall be applied by the method commonly referred to as "triple extrusion" (i.e., the conductor shield, insulation, and insulation shield shall be applied in a continuous one-pass process). The insulation and insulation shield will be applied in a common extruder head.

8.7.1.6 Shielding

8.7.1.6.1 Shielding on cables rated above two kV consists of:

- Non-metallic shielding: Insulation shield strip tension shall be seven to nine pounds
- Semiconductor conductor screen
- Semiconductor insulation screen
- Copper concentric neutral

8.7.1.6.2 The concentric neutral shall consist of annealed copper wires applied helically and spaced. The wires shall be applied directly over the semi-conducting insulation shield with a left-hand lay of not less than six or more than 10 times the diameter over the concentric wires.

8.7.1.7 Neutrals

8.7.1.7.1 Cables with a concentric neutral shall handle the maximum single line-to-ground fault current for at least 30 cycles.

8.7.1.7.2 Neutral conductors of grounded neutral systems indicated on the drawings shall be of the same insulation materials as the phase conductors except with a 600 V insulation rating.

8.7.1.8 Grounds

8.7.1.8.1 Insulated copper

8.7.1.9 Jackets

8.7.1.9.1 Direct buried cables shall be rated for direct bury.

8.7.1.9.2 A black non-conducting linear low-density polyethylene compound shall be extruded over the metallic shields. The concentric neutral wires shall be encapsulated.

8.7.1.9.3 Construction shall be so the jacket does not adhere to the insulation shield or metallic shield to each other. The compound to be used shall be identified in the manufacturer's proposal.

8.7.1.10 Special Tolerances

8.7.1.10.1 The diameter over the insulation and over the insulation shield shall meet the requirements of AEIC CS8 latest revision except as specified below.

8.7.1.10.2 After receipt of an order, drawings depicting all cable components and nominal outside diameters for each successive layer shall be provided. The drawings shall also include a table showing the shield fault current capacity in amperes at 200° C for cycles 2, 6, 10, 16, 20, 24, 30, and 60.

8.7.1.11 Marking of Insulation Shield

8.7.1.11.1 The outer surface of the insulation shield shall be durably marked with the manufacturer's name, date of manufacture, and notice that material is semi-conducting and must be removed when splicing and terminating.

8.7.1.12 Cable Identifications

8.7.1.12.1 The outer jacket surface of the cable shall be indent printed as specified in ANSI/ICEA S-94-649 latest revisions.

8.7.1.12.2 Legible sequential footage marker numbers at a minimum of two-foot intervals shall be provided. One cable of a triplexed assembly must have sequential footage marker numbers at a minimum of two-foot intervals.

8.7.1.12.3 Three red stripes shall be extruded into the jacket. Each stripe shall have a nominal depth of 15 mils and a nominal width of 350 mils. The stripes shall be evenly spaced at 120-degree intervals around the circumference.

8.7.1.12.4 Per NESC requirements, all cable jackets will be indented or embossed with a lightning bolt.

8.7.1.12.5 Phase markings shall be provided on all three cables of an assembly. The markings may be: Cable 1 - One or Red, Cable 2 - Two or White, and Cable 3 - Three or Blue.

8.7.1.13 Direct burial aluminum cables are acceptable, contingent upon Owner approval, provided the cable is suitable for the environment, and all direct buried cable will be backfilled with Owner-approved material on all sides predicated that soil conditions are favorable as determined by the final geotechnical engineering investigation.

8.7.1.14 Minimum bend radius and maximum side-wall pressure shall be calculated and observed for all power cable installations. Conductors shall be terminated using compression fittings. Conductors shall be adequately supported and arranged in a neat and orderly manner.

8.7.1.15 Connection boots are preferred at switchgear and motor connections but when taping is required, all joints shall be taped with TPC Vulko wrap or approved self-vulcanizing tape.

8.7.1.16 Contractor shall furnish and install stress cone terminations on the MV cable at each of the substation termination structures. Terminations shall be 3M Model 7666-S-8-19-AL-3P-BT or approved equivalent for the applicable voltage system.

8.7.1.17 Contractor shall furnish and install 600-amp, dead break elbows as required for all pad-mounted, step-up transformer MV terminations and sectionalizing cabinets. The elbow connectors shall be 600 A, three-phase rated (21.1/36.6 kV) dead break and shall meet the full requirements of ANSI/IEEE Standard 386.

8.7.1.18 Where feasible, a minimum of 18 inches of excess slack shall be provided to allow re-termination in the event of failure.

8.7.1.19 The DC cable connections to the PCS shall be made with compression or shear bolt lug connections. Mechanical set screw lug connections are not acceptable.

8.8 LV Cable

8.8.1 LV cable and terminations shall be in accordance with the below requirements:

8.8.1.1 Multi-conductor control and power cable shall be rated 600 V, 90 °C, stranded copper or aluminum (as specified in the design) conductors, XLP or EPR insulation and an overall PVC, CPE or CSPE cable jacket. Control and power cable sizes larger than 1/0AWG shall be single conductor construction with separate ground conductor. Power cable sizes smaller than #2AWG shall be three-conductor copper cable with green-insulated ground conductor.

8.8.1.2 Single conductor wire and cable shall be rated for the appropriate voltage and temperature. Single conductor tray cable greater than #1/0 AWG shall have EPR insulation with a PVC, CPE, or CSPE cable jacket. Non-jacketed FREP insulation with appropriate UL flame test may also be used for large single conductor cables.

8.8.1.3 Single pair instrument cable shall be rated 600 V, XLP, or PVC insulation, twisted shielded pairs with drain wires and a PVC, CPE, or CSPE cable jacket.

8.8.1.4 Multi-pair instrument cable shall be rated 600 V, XLP, or PVC insulation, twisted shielded pairs with drain wires, overall shield, and a PVC, CPE, or CSPE cable jacket.

8.8.1.5 All custom control panel wiring shall be insulated with 600 V NEC type SIS insulation and all panel wiring shall have wire numbers for identification. Vendor supplied control panels of a proven field design may provide their field proven cable insulation.

8.8.1.6 The allowable ampacity of power cables shall be in accordance with ICEA and NEC requirements.

8.8.1.7 Lighting and fixture power supply cable shall be specified with 600 volt insulation.

8.8.1.8 Cables shall meet IEEE 383 flame test requirements.

8.8.1.9 For 1500 Vdc, LV cable shall be rated 2kV, 90°C, stranded copper or aluminum conductor (as specified in the design) with insulation conforming to UL-4703.

8.8.1.10 AC and DC cable burial depth and conduit fill shall meet the requirements of the NESC and, when required, by the AHJ and the NEC.

8.8.1.11 The individual conductors of multi-conductor cables shall be identified by printing numbers (1, 2, 3, etc.) on single-color insulation or jacket (Method 4, Paragraph E.3.4, NEMA WC- 57).

8.8.1.12 Minimum bend radius and maximum sidewall pressure shall be calculated and observed for all power cable installations.

8.8.1.13 All conductors shall be terminated in accordance with manufacturer specifications and recommendations. Conductors shall be adequately supported and arranged in a neat and orderly manner.

8.8.1.14 Cable termination boxes for high-current, single-conductor power cables shall be designed to avoid cable heating due to closed magnetic loops.

8.9 Fiber Optic Cable

8.9.1 Cables for SCADA and control system communications shall be routed in conduit. When redundant communications are required, they shall be routed in separate conduits. Fiber optic cables routed in any open areas or in trench way shall be in innerduct.

8.9.2 Fiber optic cables shall have a flame retardant, moisture and UV resistant, rugged, and durable outer jacket. It shall be rated for outdoor aerial and duct, indoor vertical riser and general purpose horizontal according to NEC Article 770.

8.9.3 The type and wavelength of the fiber shall meet the SCADA system or equipment supplier's requirements. Fiber cables shall be 12 or 24-strand, single-mode throughout the project site. All fiber strands shall be terminated on the fiber patch panel with LC type connectors or approved equal. Fiber optic cables and terminations shall meet ANSI/TIA/EIA-568-B. A field test shall be provided for all fiber optic cables which identifies each cable, certifies that it meets the ANSI/TIA/EIA-568-B test specification and provides pertinent test data for each cable including insertion loss.

8.9.4 Multicore fibers shall be pulled from area to area and terminated in fiber optic patch panels using the manufacturer's recommended cable breakout and termination kits. Fiber jumpers utilizing Owner-approved connectors shall be used from the patch panel to the final device except where specific manufacturer's equipment requires a different type connector.

8.9.5 Copper communications cables such as for device net, RS-485, or other device communications shall have the same requirements as for fiber cable.

8.10 Control and Instrument Cable

8.10.1 General service control cables shall be rated for 600V. Insulation and overall jacketing material shall be 150 °C Tefzel (ETFE) or 90 °C XLPE. Minimum conductor size shall be 14 AWG. Multiconductor cables shall be used for all applications.

8.10.2 General service instrument cable shall be rated for 600V. Insulation and overall jacketing material shall be 150 °C ETFE, or 90 °C XLPE. They shall consist of twisted pairs or triads with an overall shield. Shielding of these cables shall consist of aluminum-polyester tape and copper drain wire. Minimum conductor size shall be 16 AWG. The shield drain wire for each instrument cable shall be insulated with a spaghetti sleeve and terminated on an ungrounded terminal. The ground wire shall be carried from the source device to the destination device without external ground contact.

8.10.3 Control conductor terminal connectors shall be compression type connectors properly sized for the conductor and the terminal. The connectors shall be constructed of copper and shall be tin plated. The interior surface of the connector wire barrel shall be serrated, and the exterior surface of the connector wire barrel shall be furnished with crimp guides.

8.10.4 Uninsulated terminal connectors shall be used for conductors terminated on devices equipped with individual fitted covers, such as General Electric Type SB-1 control switches.

8.10.5 Preinsulated ring type terminal connectors shall be used on all current and potential transformer circuits. All terminal connectors for conductors equal to or smaller than 8 AWG shall be preinsulated ring type.

8.10.6 Preinsulated terminal connectors shall include a vinyl sleeve, color coded to indicate conductor size.

8.10.7 Each terminal block, terminal, conductor, relay, breaker, fuse block, and other auxiliary device shall be permanently labeled to coincide with the identification indicated on the drawings.

8.10.8 All cables shall be marked with the designated cable or run number and the destination (device at the opposite end of the cable). The marker shall be white, slip-on generated by a commercially available wire label maker; Brady, Panduit, etc. For example:

8.10.8.1 12AAPH (cable run number)

8.10.8.2 TO JUNCTION BOX 1BMTB03 (destination)

8.10.9 Individual conductors of multiconductor cables shall be marked with the designated functional wire name. Marking methods shall be the same as above. For example:

8.10.9.1 1AQ-PT004+(functional wire name)

8.10.10 Where wiring passes thru terminal blocks that can be labeled (such as GE EB-25 style blocks), new wire names shall be neatly written or printed and affixed to the blocks.

8.10.11 Conductor identification shall be permanent; unaffected by age, heat, solvents, or steam; and not easily dislodged. Adhesive labels are not acceptable.

8.11 Cable Accessories

8.11.1 Lugs and Connectors:

8.11.1.1 Lugs:

8.11.1.1.1 Compression type

8.11.1.1.2 Standard: UL 486B for aluminum and copper cables

8.11.1.1.3 Voltage rating: Up to 35 kV

8.11.1.1.4 Current rating: Continuous operation at the rating of the cable

8.11.1.1.5 Material: Tin-plated copper

8.11.1.1.6 Number of holes: Two or as approved

8.11.1.2 Splice connectors:

8.11.1.2.1 Standard: UL 486B for aluminum and copper cables

8.11.1.2.2 Voltage rating: Up to 35 kV

8.11.1.2.3 Current rating: Continuous operation at the rating of the cable

8.11.1.2.4 Material: Tin-plated copper

8.11.2 Terminations:

8.11.2.1 End caps:

8.11.2.1.1 Cold or hot shrink

8.11.2.1.2 Used to environmentally seal and mechanically protect exposed cable ends

8.11.2.2 Cold shrink kits:

8.11.2.2.1 Standard: IEEE 48, Class 1 termination

8.11.2.2.2 Voltage rating: Same as the cable rating

8.11.2.2.3 Current rating: Continuous operation at the rating of the cable

8.11.2.2.4 One-piece design, where high-dielectric constant stress control is integrated within a skirted insulator made of silicone rubber

8.11.2.2.5 Suitable for contaminated indoor and outdoor locations

8.11.2.3 Molded rubber kit:

8.11.2.3.1 Standard: IEEE 48

8.11.2.3.2 Voltage rating: Same as the cable rating

8.11.2.3.3 Current rating: Continuous operation at the rating of the cable

8.11.2.3.4 One-piece design or modular with stress cone and skirts, where high-dielectric constant stress control is integrated within a skirted insulator made of EPDM rubber

8.11.2.3.5 Suitable for contaminated indoor and outdoor locations

8.11.2.4 Elbow connectors:

8.11.2.4.1 Standard: IEEE 386

8.11.2.4.2 Voltage rating: Same as the cable rating

8.11.2.4.3 Current rating: 200A

8.11.2.4.4 One-piece design, comprised of an insulation shield, insulation layer and an outer shield constructed of EPDM rubber

8.11.2.4.5 Deadfront, loadbreak type with:

- Hot stick pulling eye
- Grounding tab
- Test point

8.11.2.4.6 Accessories to be constructed in a similar manner as the elbow connector:

- Bushing inserts
- Bushing well plugs
- Feed thru inserts
- Protective caps

8.11.2.5 Cable Shield Grounding Adapters:

8.11.2.5.1 Type: Molded rubber with constant force spring and solder-blocked tinned copper braid pigtail.

8.11.2.5.2 Waterproof, providing a positive seal for the cable jacket.

8.11.2.5.3 May be integral with termination of splice device with engineer's approval.

8.12 PCS Stations

8.12.1 Central PCS equipment consisting of bi-directional inverters, MV transformer, and ancillary equipment shall be provided in a close-coupled skid configuration unless PCS units are included within battery enclosures. Enclosures shall be NEMA 4X rated where available, but in all cases shall be sufficient for the installed conditions and long term reliability of the equipment.

8.12.2 PCS Stations shall have all associated SCADA and communications included in the skid for associated bi-directional inverter, transformer, and ancillary equipment.

8.12.3 Factory Acceptance Tests (FATs) shall be performed for all PCS stations. Contractor shall submit FAT plans and procedures for Owner review and approval. Plans shall be adjusted as requested by Owner to ensure adequate and appropriate testing is included.

8.12.4 PCS Stations will be installed outdoors, exposed to all weather, direct sunlight, and extreme hot and cold conditions and shall be capable of continuous operation when exposed to the full range of site operational environmental conditions. Final PCS station design shall consider impacts to actual performance resulting from temperature derates. The PCS stations shall be able to provide full site nameplate rating at maximum operational ambient temperature identified in Table 3.1 or 50 °C, whichever is greater, and considering direct sunlight exposure of the PCS Station.

8.12.4.1 See the Site Design Data section for the range of ambient design conditions to be considered.

8.12.4.2 PCS stations shall have appropriate enclosure that protects internal hardware and circuitry from site environmental conditions.

8.12.4.3 PCS stations shall be provided with heating and cooling systems, as required and recommended by the manufacturer, based on environmental conditions at each project site.

8.12.5 PCS stations shall be designed for high reliability and a minimum design life of 20 years, with the maintenance schedule for time between major component repair or replacement of at least 10 years. Contractor may propose PCS units that do not meet these criteria, but must indicate in bid the non-conforming aspects. Design and design life shall be supported with manufacturer's established procedures. These procedures should incorporate design for reliability approaches with design calculations, component selection, and component design margin supported by Failure Modes and Effects Analysis (FMEA), MTBF calculations, design verification testing, performance validation testing, and accelerated life testing such as Accelerated Life Test and Highly Accelerated Life Test. Final PCS manufacturer and model to be confirmed and approved by Owner.

8.12.6 PCS Stations shall be UL listed to UL 1741 and in accordance with IEEE 2800.

8.12.7 PCS station design shall incorporate bi-directional inverter and transformer electrical configurations. PCS station design shall verify equipment coordination to handle step-up and step-down operation, static shield requirement between high side and low side, handling over-voltages up to 10% continuously, required winding impedance, suitability for operation with pulsed inverter and maximum voltage to ground as required, and efficiency meets or exceeds Department of Energy (DOE) targets.

8.12.8 PCS stations shall be accessible and serviceable by the service truck and typical vehicles and equipment required for inverter replacement or service.

8.12.9 The PCS stations shall include the necessary DC circuit breakers and disconnect switches, AC circuit breakers and disconnect switches for the inverters to function properly as part of a power energy storage facility. Means shall be provided to disconnect equipment such as inverters, batteries, charge controllers, and the like from all ungrounded conductors of all sources. If the equipment is energized from more than one source, the disconnecting means shall be grouped and identified.

8.12.10 Additional PCS- stations may be added to the site to perform reactive compensation and voltage control in lieu of a capacitor bank, based on site reactive power study.

8.12.11 Output current harmonics shall contain <5% total harmonic distortion at rated power output.

8.12.12 PCS stations shall be designed and selected that PCS power output will not be limited to below PCS maximum power output rating during any operating scenario where power limiting, or 'clipping', is occurring.

8.12.13 PCS stations shall be from the approved vendor list as provided below:

8.12.13.1 Power Electronics

8.12.13.2 Siemens

8.12.13.3 SMA

8.12.13.4 TMEIC

8.12.13.5 Owner may approve other vendors at Owner's discretion (subject also to MISO interconnection requirements and compatibility)

8.12.14 PCS stations shall be lockable.

8.12.15 Pad Mount Transformers

8.12.15.1 Transformer shall be dead-front padmount, loop-fed and designed for Inverter based generation applications with continuous step-up operation. Transformer shall meet all requirements of the connected PCS including grounded electrostatic shield and pulse withstand if required by manufacturers.

8.12.15.2 Transformer shall be provided with primary overcurrent protection with partial range current limiting and Bayonet fuses at a minimum, under-oil surge arresters and equipped with under-oil, visible load break rated gang-operated disconnect switch, capable of keeping the loop closed while the transformer is de-energized.

8.12.15.3 Transformer coolant shall be non-toxic, biodegradable insulating fluid, with secondary containment, if required.

8.12.15.4 Step-Up Transformer(s) shall have high-side DETC with 5 positions, nominal + two 2.5% adjustments +/-.

8.12.15.5 Transformers shall be rated as 99% efficiency or greater at full load, with no-load losses less than 0.25% of the rated MVA.

8.12.15.6 Pad mount transformers shall be provided with primary overcurrent protection.

8.13 Switchgear

8.13.1 All switchgear shall be metal-clad construction with front access doors unless approved otherwise by Owner. The Equipment shall be selected from the manufacturer's standard product range and be fully tested as a product in accordance with relevant Standards.

8.13.2 Installation clearance of all switchgear shall follow the guidelines set forth by the NEC.

8.13.3 The main bus bars, together with the tee-off bus bars connecting the main bus bars to the isolating devices on all incoming and outgoing circuits, shall be contained in a separate compartment(s) within the switchgear. The bus bars shall be air insulated except where solid insulation is a design feature. The main bus bars shall have the same current rating throughout their length. These compartments shall have special glass ports with unobstructed view of bus and terminations for use with thermal-imaging cameras without the removal of doors or panels while energized. Switchgear shall provide visible indication of switch position. All MV switchgear shall be supplied with remote racking for those breakers that are racked in and out of the bus. Switchgear shall be of arc resistant construction (Type 2B).

8.13.4 Apparatus that has to be removed from a panel or cubicle for maintenance or replacement purposes shall be of the draw-out type.

8.13.5 Protection shall be provided against finger contact with live parts within switchgear with the access door open and cover plates removed. This requirement includes cable termination compartments and draw-out units when in the withdrawn position.

8.13.6 Switchgear shall be provided with LOTO capabilities.

8.13.7 LV switchgear shall have minimum of two spare breakers and 10 to 15% breaker space for Owner's use. Spare breaker shall be identical type and rating so Owner can replace them with the bad one in service if necessary. Contractor shall provide similar breaker settings for the spare breakers.

8.13.8 Switchgear shall include all accessories as required to rack in and rack out the breakers.

8.14 Communications Infrastructure

8.14.1 This Section defines Contractor's requirements and work scope with respect to in-Project communications and IT infrastructure.

8.14.2 Contractor shall provide communication and network equipment to connect the Project to Owner's offsite control and monitoring facilities

8.14.3 Contractor shall be responsible for arranging and coordinating temporary telephone and data networking service from offsite providers during construction. Contractor shall arrange and coordinate permanent data connections from offsite providers and assign to Owner. Contractor shall coordinate with Owner on the appropriate timing and use of these services.

8.14.4 Communications wiring must meet following standards

8.14.4.1 Fiber runs shall meet NEC article 770 specifications and be rated for indoor or outdoor use.

8.14.4.2 Fiber shall be outdoor rated 24 or 48 single mode fiber with SC termination.

8.14.4.3 Single mode fiber from the substation control house to the inverters shall be provided with a Loop ring connection from substation fiber switch to each skid.

8.14.4.4 Separate single mode fiber from the substation control house to each met station should be provided with F/O to Cat5/6 media converter at each end. This fiber pair should not be part of inverter network.

8.15 AC and DC Collector Systems and Cable Installation

8.15.1 AC and DC collection systems shall be installed underground.

8.15.1.1 The use of an aboveground DC collection system can be provided as an option for Owner consideration. Above ground DC collection systems that will be considered must be designed for all environmental and physical loading conditions and which do not restrict access for equipment maintenance or replacement, do not block row end access, and are protected from site maintenance activities such as snow plowing.

8.15.2 All cable bedding shall be free and clear of aggregate. All backfill shall be clean native material that, if required, has been filtered to have all particles less than 3/8 inch. Backfill material shall meet thermal calculation requirements and cable manufacturer's recommendations.

8.15.3 All Project cabling and load break switches will be labeled.

8.15.4 DC cable sizing and separation spacing shall be determined in accordance with applicable IEEE codes and be based on the site Rho values shall consider site parameters such as soil temperature load factor limitation, cable burial depth and number of parallel circuits in the same trench.

8.15.5 Splicing of cables is prohibited.

8.15.5.1 Splices may only be allowed to repair cabling which has been damaged after full installation of cabling (full run has been backfilled and compacted) and upon written approval from Owner. All splices shall be documented with survey points.

8.15.6 For any cabling run above ground, UV resistant, heavy duty tie wraps or other mechanical fastening system, designed for the life of the project, shall be used to secure cables.

8.15.7 Cabling installation and fastening system shall prevent wear of cabling.

8.16 Grounding System

8.16.1 Grounding of BESS site components and all equipment will meet manufacturer's requirements and industry standards.

8.16.2 As a minimum the grounding system shall be designed in accordance with IEEE 80, IEEE 665, ANSI C2, and where applicable, the National Electric Code (NEC).

8.16.3 All grounding hardware shall be listed and approved for application.

8.16.4 Because of constraints imposed by the design of certain equipment it may be necessary to adopt grounding practices which differ from those specified in the following Sections. The ultimate responsibility for the correct operation of the equipment shall lie with the Contractor. Where the Contractor finds it impossible to comply with any of the following Sections, he shall submit alternative proposals for evaluation and written approval by the Owner.

8.16.5 All electrical equipment that is part of an integral shipping unit or assembly shall be furnished with bare copper grounding conductor extending to a central ground connection lug. The lug shall be suitable for field connection to the station ground grid.

8.16.6 Isolated logic system or single-point ground connections required for proper operation of electronic equipment shall be insulated from the equipment safety ground. Such connections shall be extended, using insulated cable, to a single termination point suitable for field connection to the appropriate ground system.

8.16.7 Electrical equipment shall include all enclosures containing electrical connections or bare conductors with the exception of control devices, such as limit switches, unless such devices require grounding for proper operation.

8.17 Lightning Protection System

8.17.1 The lightning protection scheme for each Project shall be designed in accordance with the requirements of NFPA 780, UL 96, and the NEC.

8.17.2 The lightning protection installation shall be UL Master Label certified. Provide field testing to verify the integrity of the lightning protection system at Project completion.

8.18 Project Electrical Studies

8.18.1 Contractor shall perform the following electrical studies and analysis to demonstrate the adequacy of the Project design:

8.18.1.1 Short Circuit Study: short circuit analysis of collection system circuits, including secondary values on inverters. The short circuit analysis and study shall be utilized in Contractor's electrical designs to support relay coordination study and equipment specification.

8.18.1.2 Reactive Compensation Study: This study is expected to be completed by MISO as part of the interconnection study. Contractor shall provide inputs such as battery inverter and PCS technical documentation and controls as part of the MISO interconnection study.

8.18.1.3 Arc Flash Study: arc flash hazard analysis of the Equipment, including all energized equipment in the collection system circuits. This analysis shall be performed in accordance with the applicable version of NFPA-70E and IEEE 1584. The study shall be performed for two cases, with and without the substation protective relays in maintenance mode. As-Built arc flash software model files shall be provided to Owner upon project completion.

8.18.1.4 Protection Coordination Study: relay and protection equipment coordination study, including detailed calculations, one-line and three-line diagrams, fuse curves, coordination curves, protected equipment data, and relay set points. Cable ampacity calculation shall be based on the 75% load factor on DC cables and 100% load factor on all LV and MV cables. Soil and ambient temperatures shall be from ASHRAE. Burial depth shall comply with NESC.

8.18.1.5 Load Flow Study: Load Flow, Voltage Drop, Reactive Power and System Loss Study in accordance with IEEE 399.

8.18.1.6 Harmonics Study: Harmonics Study Analysis shall be performed in accordance with the requirements and procedures provided in IEEE 399.

8.18.1.7 Grounding and Step and Touch Potential study

8.18.1.8 Overvoltage analysis

8.18.1.9 Insulation coordination

8.18.1.10 Ferroresonance Analysis (if required)

8.18.1.11 Other studies as required by the GIA.

9.0 INSTRUMENT AND CONTROL SYSTEM

9.1 General

9.1.1 All instruments and equipment required for the commissioning, start-up, testing and O&M of the Project shall be supplied and installed. Contractor shall be responsible for any field calibration of instruments.

9.1.2 All instruments and equipment shall be designed in a manner which assures reasonable protection against mechanical damage, wetting, or extremes of heat or cold. Final locations and orientations must be selected for accessibility, repair, and calibration in place, easy access to the rear of the instruments (if needed), and for disconnection without resorting to cutting, burning, or welding.

9.1.3 The instrumentation and control equipment shall enable operations of the Facilities to be carried out in a safe, effective and reliable manner without invoking equipment or system operational limits.

9.1.4 The design of the instrumentation and control equipment shall to the greatest extent employ recognized principles leading to:

9.1.4.1 A safe operating environment for personnel

9.1.4.2 Protection of the Project equipment from damage

9.1.4.3 High availability

9.1.4.4 Maintainability

9.1.4.5 Power production at the lowest possible cost

9.1.4.6 Minimization of operating and maintenance labor

9.1.4.7 Protection and detection of intrusion and malicious software

9.1.5 The Local control systems shall allow for proper system maintenance, testing, and commissioning and include provisions for equipment isolation and essential tripping functions. Sufficient alarms and indications shall be provided to remotely verify the local system is configured for the intended operating role and functioning within design parameters.

9.1.6 The extent of remote manual controls, indications, automatic modulating controls, automated sequences and Project and personnel protection systems shall be such as necessary to enable all routine operations of the facilities to be monitored by. All equipment shall be designed such that any interruption in electrical power supply shall not result in injury to personnel or damage to systems or equipment.

9.2 Instrument Cabinets and Local Control Panels

9.2.1 Local instrument rack, enclosure, and cabinet installation

9.2.1.1 Instrument racks, enclosures, and cabinets shall be secured to structural steel or to concrete. Racks, enclosures, and cabinets shall be electrically grounded. Bolting to bare or galvanized metal shall be used for attaching a ground strap.

9.2.1.2 The racks, enclosures, and cabinets shall be anchored in place so that they are level and plumb and properly aligned in accordance with the above mounting requirements.

9.3 Local Instrument Cabinets and Racks

9.3.1 Instrument and Control Wiring and Instrument Cabinet Wiring

9.3.1.1 Both ends of conductor or wire pair shall be identified with a wire number or instrument tag number.

9.3.2 Marking

9.3.2.1 All instruments shall be tagged with the appropriate instrument tag number. Tags shall be secured with stainless steel wire with ends crimped together.

9.3.2.2 Each local instrument cabinet shall have a stainless steel tag permanently affixed to the cabinet front.

9.3.2.3 Each cabinet mounted instrument shall have a tag affixed to the instrument.

9.4 SCADA System

9.4.1 Contractor shall provide a complete functional and integrated SCADA. As part of this scope the Contractor shall:

9.4.1.1 Provide all configuration, coordination, integration, and testing of SCADA hardware required for furnishing a fully functioning system.

9.4.1.2 Install system in accordance with manufacturer's written instructions.

9.4.1.3 Inspect equipment covered by these Specifications.

9.4.1.4 Supervise adjustments and installation checks.

9.4.1.5 Maintain and submit an accurate daily or weekly log of all commissioning functions.

9.4.1.5.1 All commissioning functions may be witnessed by the Engineer.

9.4.1.5.2 All reports shall be cosigned by the Contractor and the Engineer if witnessed.

9.4.1.6 Conduct startup of equipment and perform operational checks.

9.4.1.7 Submit a site test report indicating how the system was tested and which items were tested.

9.4.1.8 Prior to energization provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation by Owner's personnel.

9.4.1.9 Demonstrate system in accordance with Acceptance Testing.

9.4.1.10 Provide training covering at minimum hardware, software, documentation, maintenance, troubleshooting, operations and setpoint adjustments.

9.4.1.11 Provide on-call technical support for a period of one year after substantial completion. Include a minimum of two site visits to work with owner on any final modifications to the logic

9.4.2 Design of the SCADA system shall be performed in cooperation between Contractor, Owner, and Transmission Owner to ensure an operational system that meets interconnection requirements. Contractor is responsible for ensuring that all network and SCADA systems integrate properly.

9.4.3 Additional requirements for the BESS SCADA systems are defined in Exhibit F – Attachment 3.

10.0 PERMITS

10.1 Contractor Permits

10.1.1 Contractor shall obtain and adhere to all Contractor Permits required by Applicable Laws.

10.2 Owner Permits

10.2.1 Contractor shall adhere to all Owner Permits required by Applicable Laws.

11.0 PROJECT SPECIFIC CONSTRUCTION SITE REQUIREMENTS

11.1 General Requirements

11.1.1 Contractor shall adhere to all construction hours as specified by the permit conditions and community regulations.

11.2 Site Management

11.2.1 Contractor shall manage the site, including all personnel, material, and activities throughout the construction phase until turnover to Owner. Contractor shall maintain the site and all site activities in compliance with all applicable permits and laws, site safety requirements, and in accordance with typical industry standards for a utility grade construction site.

11.3 Construction Power

11.3.1 Contractor shall be responsible for providing construction power to site, as well as distribution infrastructure onsite for construction power

11.4 Construction Support Facilities

11.4.1 Contractor shall provide all necessary temporary facilities, inclusive of include portable toilets and hand wash stations, at the site to support its staff and labor force and the delivery, unloading and storage of equipment and materials.

11.4.2 Contractor shall provide one 50- x 12-foot furnished office trailer for to support four Owner on-site staff. Inclusive of power, HVAC, internet, and drinking water. Owner shall share parking and portable toilet facilities as provided in 11.2.1.1.

11.4.3 Any temporary trailers and storage facilities shall meet any state, federal, or local requirements.

11.5 Construction Security

11.5.1 Contractor shall, at their discretion and responsibility, provide reasonable site security during construction and commissioning.

12.0 CLIENT SPECIFIC REQUIREMENTS

12.1 Site Specific (AES Indiana) Technical Requirements

12.1.1 The Project shall meet all AES Indiana technical requirements unless otherwise agreed to in writing.

12.2 Additional Clearances for Overhead Lines

12.2.1 We will meet the following AES Indiana additional clearances on top of those required by NESC:

12.2.1.1 Two feet additional clearance over any crossings (railroads, roads, other circuits)

12.2.1.2 One foot additional clearance over all other areas not designated as crossings

12.2.1.3 Using 10% over-voltage when determining clearances (instead of NESC 5%)

12.3 PCS Transformer

12.3.1 The PCS transformer will be designed with the following:

12.3.1.1 A concrete, secondary containment area to constrain transformer oil leaks.

12.3.1.2 Containment area shall be capable of holding the maximum volume of the transformer's oil, plus an amount for rainwater (+10% volume or +6 inches).

13.0 ENVIRONMENTAL

13.1 Environmental Control Program

13.1.1 Contractor shall develop and maintain an environmental control program to assure that all construction and start-up activities associated with the Project conform to best environmental practices, federal, state and local regulations, Applicable Permits, and any other construction constraints identified in the Project's environmental permitting process. The program shall include an Environmental Plan and all other relevant program documents (i.e., permit matrices, storm water pollution prevention plan, spill prevention, control and countermeasure plan, copies of permits, etc.). The Environmental Plan will provide all relevant references for the project's environmental management.

13.1.2 The environmental control program shall include the processes that will be followed in order to comply with Applicable Laws and Applicable Permits. The plan shall include, at a minimum, the following:

13.1.2.1 List of responsible parties with contact numbers

13.1.2.2 Map locating construction facilities and environmental control areas

13.1.2.3 Erosion and sedimentation control

13.1.2.4 Fuel and waste storage management

13.1.2.5 Chemical inventory tracking and management

13.1.2.6 Liquid, solid, universal and hazardous waste management

13.1.2.7 Basis of decision for waste characterization

13.1.2.8 Surface water pollution prevention

13.1.2.9 Construction debris control

13.1.2.10 Traffic control

13.1.2.11 Revegetation Plan

13.1.2.12 Construction facilities management

13.1.2.13 Personnel training

13.1.2.14 Program monitoring and documentation

13.1.2.15 Non-compliance reporting procedures

13.1.2.16 Oil Spill Response Plan

13.1.2.17 SPCC Plan

13.1.2.18 Emergency action procedures

13.1.2.19 The Environmental Plan document shall also include a matrix of permit compliance activities, due dates, responsible person and current status. Copies of Contractor's environmental permits applicable to the Project shall be included in the document

13.1.3 Contractor shall develop and provide to Owner the operational SPCC Plan.

14.0 TRAINING

14.1 General Requirements

14.1.1 This Section describes the Contractor's responsibilities in regards to personnel training.

14.1.2 Training session breakdown and organization will be established with Owner after award.

14.1.2.1 Contractor shall include seven days of onsite training as its base proposal. Training sessions on-site shall be planned for eight hours per day, not including a 30-minute lunch period.

14.1.2.2 Contractor shall account for equipment vendor representation on site as required to support this seven-day training program and to provide a complete training program to allow for Owner's O&M staff to safely operation and maintain the complete Project.

14.1.2.3 Contractor shall provide rates for additional training days and shall accommodate additional training as requested by Owner.

14.1.3 Contractor shall develop, implement, and present a training program covering all aspects of the O&M of the Contractor's equipment. Contractor shall also provide hands on training for the operators during equipment and system commissioning while providing site services during these activities. Training shall include any OEM specific training required to certify Owner staff in operations of equipment as required for maintaining equipment warranty.

14.1.4 Contractor shall use qualified trained personnel as instructors, fluent in both oral and written English. Personnel shall be employees of the Contractor's firm with a minimum of five years experience with the firm and equipment. Instructors shall have previous

experience in classroom and field training. Contractor shall use qualified instructors from sub-suppliers when appropriate.

14.1.5 Contractor shall provide a listing of any special prerequisite training or knowledge level of the personnel attending the training program.

14.1.6 On-site training shall be provided in classroom format as well as via site orientation walkthroughs covering all aspects of O&M.

14.1.7 As a minimum the following training shall be provided:

14.1.7.1 On-site classroom sessions for supervisory, O&M personnel in overview of equipment and general information pertinent to the O&M of the equipment

14.1.7.2 On-site walk-through for supervisory, O&M personnel to provide overall familiarization with the location and function of all major components and systems

14.1.7.3 On-site classroom and field sessions for specific groups of O&M personnel to cover group-specific aspects of the equipment.

14.1.7.4 Sessions shall cover the system processes, protection systems, local operations and operations from the Control House and SCADA systems.

14.1.7.5 BESS Familiarization and Operation

14.1.7.6 BESS Preventative Maintenance

14.1.8 Contractor shall provide the training facilities and equipment required to execute the training program. All material, training aides, and handouts shall be provided by Contractor.

14.1.9 Contractor shall provide each participant in the training session a training manual. The training manual shall include O&M information for all equipment in the Contractor's Work. A minimum of three hard copies of the Project O&M manual shall also be made available at each session for participant reference and to support the training activities.

14.1.10 Training manual content shall include but not be limited to:

14.1.10.1 Training Objectives

14.1.10.2 Equipment overview

14.1.10.3 Major component description

14.1.10.4 Controls: Instrumentation, controls, and interlocks

14.1.10.5 Principal of operation including operating parameters, start-up, normal operation, shutdown, infrequent operations modes, emergency procedures, and maintenance.

14.1.10.6 Support systems needed for operation

14.1.10.7 Visual aids of equipment and system design.

14.1.10.8 Hazards and safety features

14.1.10.9 Routine maintenance

14.1.10.10 System controls and operations

14.1.11 Contractor shall provide the electronic files to the Owner in the editable native format as well as a duplicate set of all training aids (i.e., actual equipment, equipment manuals, view graphs) for future training needs. Training sessions may be videotaped by the Owner for use in follow-up and new hire training.

14.1.12 In addition, the Contractor and Owner shall coordinate a walk-thru, inspection, and training to the local fire marshal or similar government official responsible for firefighting. This training shall include an introduction to the system, method of emergency shutdown, and procedures for safely combating fires within the BESS, PCS, and Control System.

14.2 Training Schedule

14.2.1 All or a part of the training shall be scheduled prior to initial startup as required to allow the operating personnel to participate in the startup of the systems.

14.2.2 Contractor shall provide a dry run of its training program two weeks in advance of the scheduled date for starting the classroom training. This dry run shall cover all aspects of the training program in an abbreviated one-day format. Any outstanding concerns will be resolved and approval of the training program by the Owner or Owner's representative will be granted. The location of the dry run will be at the Owner's selected location.

14.2.3 The following items shall be submitted to the Owner 8 weeks prior to the scheduled classroom training and shall comply with the pertinent provisions of Exhibit F - Attachment 10:

14.2.3.1 Training course outline

14.2.3.2 Training manual

14.2.3.3 Preliminary training schedule

14.2.3.4 List of training aids

14.2.3.5 Training facilities required

Contractor shall incorporate comments resulting from the Owner review of all training materials.

15.0 WARRANTY

15.1.1 Contractor shall provide a transferable warranty from the BESS equipment supplier that warrants the BESS to be free of defects and of good workmanship for a period of three years from substantial completion as defined in the Contract. Any defects or repairs shall be performed by the BESS equipment supplier at no charge to the Owner including any transportation or handling to remove the system from service.

16.0 COMMISSIONING, START-UP AND TESTING REQUIREMENTS.

16.1 General Requirements.

16.1.1 Contractor shall develop and execute an acceptance testing, commissioning, and Project startup plan for the BESS plant, as well as a performance testing plan. These plans together, shall comprise the SU&C Execution Plan and shall describe in detail all aspects of the SU&C program including how commissioning and testing activities shall be incorporated into the design, procurement and construction of the Work. The SU&C Execution Plan shall be prepared and executed in accordance with the scope and requirements included in Exhibit F Attachment 5 and Exhibit F Attachment 6.

16.1.2 Contractor shall be responsible to coordinate requirements activities with local transmission company including coordinating Lock Out, Tag Out procedures for personnel safety, schedule, initial energization procedure, testing, and checkout.

16.1.3 Electrical and SCADA commissioning shall include testing validating range of operation to meet Transmission MIA requirements, MISO DIR requirements (as applicable), and NERC testing requirements. Commissioning documentation will meet requirements for reporting on applicable NERC standards.

16.1.4 Provide the services of technically competent field services representative(s), including representatives of BESS equipment supplier subcontractors as needed, to advise and consult during field erection, pre-commissioning, start-up, commissioning, and tuning activities to ensure all equipment is installed in accordance with manufacturers requirements and Prudent Industry Practice.

16.1.5 For general requirements refer to Exhibit F – Attachment 5.

16.1.6 Following the erection of the BESS and auxiliaries, a systematic, comprehensive commissioning program shall be completed by Contractor, with technical direction provided by the BESS equipment supplier. The BESS equipment supplier shall provide a commissioning manual which shall include all necessary commissioning procedures, instructions, drawings and test forms for their equipment.

17.0 PROJECT ADMINISTRATION

Contractor shall establish a Project Management Program to properly administer and execute the Project. The requirements of this Project Management program are provided in Exhibit F – Attachment 9.

18.0 PROCUREMENT, MATERIAL MANAGEMENT, AND SPARE PARTS

18.1 Specifications

18.1.1 Contractor shall prepare equipment specifications for procurement of equipment for the Project. Contractor shall purchase all equipment and materials, consumables, and services to complete the Project with the exception of Owner provided equipment and services as specifically defined herein.

18.1.2 Where specific requirements for equipment are included herein, Contractor shall ensure that these requirements are included in their specifications and are complied with by the selected manufacturer. Contractor shall be responsible for proposing resolutions to any exceptions taken by manufacturers to the requirements outlined herein and obtaining the Owner's concurrence with these resolutions prior to accepting the exceptions and purchasing.

18.2 New Material

18.2.1 Contractor’s equipment and material supplied shall be new and unused, proven effective and reliable for its application, and designed for industrial service typical of power plant environments (Prudent Utility Practices). Used equipment or material is unacceptable. The use of recycled material combined with virgin material in the production of a new product is allowed.

18.3 Selection of Equipment Suppliers

18.3.1 Contractor shall procure equipment in accordance with the requirements of the Agreement from reputable suppliers who normally produce the type of equipment specified for use in heavy industrial applications.

18.3.2 Where specific requirements for equipment are included herein, Contractor shall ensure that these requirements are included in Contractor's specifications and complied with by the selected manufacturer. Contractor shall be responsible for proposing resolutions to any exceptions taken by suppliers to the requirements outlined herein.

18.3.3 For other equipment, manufacturers and model numbers listed in this Contract are representative only of the quality of equipment proposed. Manufacturers and model numbers of equal quality may be substituted for those listed in this Contract.

18.4 Vendor Inspections

18.4.1 The Owner reserves the right to participate or cause Owner's representative to participate in scheduled vendor inspections of any equipment. Contractor shall submit to the Owner a listing of their planned inspections for the equipment to be supplied.

18.5 Material Management

18.5.1 This section provides packaging and shipping requirements for all materials to be delivered to the Site.

18.5.2 A top priority of the Project is safety. All parties must strive to ensure safe handling and transport of shipments and to avoid any action that could jeopardize safety of workers or result in damage to property. It is Owner's goal to complete the Project with zero accidents and incidents.

18.5.3 Contractor shall be responsible for controlling and ensuring timely delivery of all shipments. Contractor shall be responsible for traffic and logistics. Contractor shall implement procedures and specifications to adequately control and ensure delivery of all materials and products, including requirements for export and import documentation package, package and container identification, packing, and preservation.

18.5.4 In general, equipment and materials will be delivered to the site by truck. Contractor shall coordinate and provide adequate on-site access roads and any necessary improvements to the entrance road.

18.5.5 Truck deliveries and traffic shall comply with permit requirements.

18.5.6 Contractor shall coordinate and perform the ordering, delivery, receipt, unloading, storage, care and custody, and management of all Contractor supplied tools, equipment, components, and material necessary for the performance of the Work.

18.5.7 Contractor shall coordinate and perform the receipt, unloading, storage, care and custody, and management of all Owner supplied materials, inclusive of previously procured and stored materials and Owner direct delivered materials necessary for the performance of the Work.

18.5.8 All hazardous materials must be packed and marked in accordance with all applicable local, state, national and international Codes.

18.5.9 A Safety Data Sheet (SDS) for all substances shipped to the Site that require an SDS in accordance with OSHA regulations shall be included with the shipment. For shipments of any dangerous, toxic, or hazardous materials, an SDS shall be furnished to the Site prior to shipment.

18.5.10 Lay down and storage areas shall be furnished as determined by the Contractor to support their work. Contractor shall furnish and install permanent storage facilities as defined under Article 3.1.3.

18.5.11 Removal and disposal of all waste material from Contractor and Owner provided materials, tools, equipment, etc. Contractor shall minimize landfill waste by recycling materials where possible.

18.5.12 Contractor shall be responsible for damage, loss, theft, casualty, shortages, shrinkage, and non-conformance of materials and equipment.

18.6 Spare Parts and Special Tools

18.6.1 One new set of special maintenance tools required for maintenance of the BESS shall be furnished. The maintenance tools shall be stored in a metal cabinet or the site storage Conex. The storage cabinet shall be provided with a hinged door that locks.

18.6.2 Provide all lifting provisions and hoists required for inspection, maintenance and overhaul.

18.6.3 Contractor shall provide, with their proposal and as a final deliverable, lists of spare parts for both SU&C and for ongoing O&M activities. That will be sourced and should be maintained by Owner for the preventive and corrective maintenance and reliable operation of all equipment within the Project.

18.6.4 Contractor shall provide Owner with a spare parts list that contains the following information:

18.6.4.1 Equipment name and tag number(s)

18.6.4.2 Part name, part number, and assembly drawing number

18.6.4.3 OEM's name, OEM part number, and assembly drawing number

18.6.4.4 O&M manual title and reference number as applicable

18.6.4.5 Quantity to be in inventory

18.6.4.6 Lead time for delivery

18.6.4.7 Storage requirements

18.6.5 Contractor shall price the supply and storage of all recommended commissioning spare parts, in accordance with manufacturer's recommendations, with their base bid.

18.6.6 Contractor shall include in their proposal a listing of all special tools required to maintain or service the equipment.

18.6.7 Contractor shall provide two sets of all special tools required to maintain the equipment. One set may be used by the Contractor; the other(s) shall remain new and provided for maintenance use only. Contractor shall indicate in their special tools list if any of the special tools will not be supplied with the equipment in the original purchase.

18.6.8 All special tools shall be given to the Owner at system turnover in serviceable condition. If a piece of equipment has more than five special tools, they shall be given to the Owner in containers or gang boxes that are labeled with the name of the equipment.

18.6.8.1 Contractor shall provide Owner with its planned schedule of preventive maintenance and frequency of spare parts replacement to allow the review of the operating spare parts list.

18.6.8.2 The Contractor shall coordinate with the Owner for the designation of spare parts storage space in the Contractor supplied O&M Building.

19.0 QUALITY PROGRAM

19.1 General

19.1.1 Contractor shall provide and implement a descriptive plan defining methods for providing quality assurance and quality control services for the Work. The plan shall require documentation adequate to assure the items or services provided meet all Contract and code requirements. Contractor shall resolve any comments to the Owner's satisfaction.

19.1.2 The Contractor's plan shall describe the methodology by which they will manage quality of the products/components they will supply and/or install for the project. This quality plan shall include both the "controls" to achieve the quality defined in the design specification and the "assurance" that those quality levels were met.

19.2 Quality Plan

19.2.1 Contractor shall define and implement a descriptive plan defining methods for providing quality assurance and quality control services for the following and other activities

specified elsewhere in the Contract Documents. The type and quantity of data provided shall take into consideration the nature and complexity of the items or services to be supplied. Data shall cover the following as applicable:

19.2.2 The type and quantity of data provided shall take into consideration the nature and complexity of the items and services to be supplied. Quality documents, such as those listed below, shall either be included in the Quality Plan to be submitted or shall be made available upon Owner-request:

19.2.2.1 Quality control program

19.2.2.2 Organization

19.2.2.3 Design and design documentation control

19.2.2.4 Procurement document control

19.2.2.5 Identification and control of purchased material, equipment and services

19.2.2.6 Material certifications

19.2.2.7 Inspection and testing, including Code mandated Special Inspections:

19.2.2.7.1 Inspection check sheets and nondestructive examination records

19.2.2.7.2 Inspection and Testing Instructions, detailed step-by-step procedures, acceptance criteria and any supplementary drawings or sketches to support activities

19.2.2.8 Control of special processes

19.2.2.9 Manufacturer's data reports (Form-U)

19.2.2.10 Control of measuring and test equipment

19.2.2.11 Handling, storage and shipping

19.2.2.12 Nonconformance items

19.2.2.13 Corrective action

19.2.2.14 Quality assurance records

19.3 Inspection and Test Plan (ITP)

19.3.1 The Contractor shall submit with its proposal a preliminary ITP for Owner review/approval prior to and as to be followed in furnishing the Work. The ITP shall define points for inspections, witnessing of tests, and final acceptance testing. The ITP of the Contractor is subject to modification as determined by the Owner for implementation of an acceptable inspection and test program. The Owner reserves the right to witness inspections and tests as deemed necessary.

19.3.2 All testing reports shall be provided to Owner.

19.3.3 Factory acceptance testing shall be performed on all major equipment and as specified for other materials and components.

19.4 Regulatory Requirements

19.4.1 Contractor shall comply with all codes, laws, and rules of federal, state, and local jurisdictions.

19.5 Quality Assurance

19.5.1 Contractor shall have in place quality forms and checklists and shall submit samples of said forms and checklists applicable to Contractor's scope of Work.

19.5.2 The Contractor shall be responsible for the following at a minimum:

19.5.2.1 Obtaining producer test reports, analyses, and certificates of compliance.

19.5.2.2 Providing documentation on appropriate forms of the results from all inspections and tests required under the specification.

19.5.2.3 Providing adequate notice, fully coordinating, and demonstrating that all required tests and inspections are performed.

19.5.2.4 Auditing implementation of the quality program procedures.

19.6 Quality Control

19.6.1 Contractor and its approved lower tier Subcontractors shall have in effect a Quality Control Program approved by the Owner or Owner's representative.

19.6.2 Contractor shall designate a Quality Control Manager to manage Contractor's Quality Control Program.

19.6.3 Contractor shall be responsible for the performance of all inspection and testing activities as set forth in, and as required to demonstrate compliance with, the drawings, specifications, referenced standards, applicable codes and industry practices.

19.6.4 Contractor shall provide competent inspection for work on site and off site.

19.6.5 Contractor shall perform required inspections and tests to determine and verify that quality of work and materials conform to specified requirements.

19.6.6 Contractor shall inform the Owner of the Work's progress and shall notify the Owner in a timely manner of the scheduled inspections and testing that will take place.

19.6.7 Special Inspections

19.7 Special Inspections

19.7.1 Special inspections shall be performed as required per the governing code.

19.7.2 Foundation Engineer of record shall include and execute a Special Inspection and Test program written in accordance with the requirements of the building code and specifically for a BESS facility. This inspection plan shall include testing of concrete elements and steel piles in addition to inspection of the structural portions of the trackers, tracker foundations, inverter foundations, and connection between base of inverter and its foundation. This plan shall be submitted to the owner for comment at the 60% level of design.

19.8 Verification

19.8.1 The Owner shall have access to the work to perform assessments, quality audits, or witness test activities during all site work and to review applicable records. Owner may designate an authorized agent to perform these activities. The authorized agent may be an employee of the Owner or an outside agency.

19.9 Non-Compliance

19.9.1 Upon identification of non-compliance with the requirements of the Contract, the Contractor shall document the non-compliance issue. For non-compliance issues where the nonconforming characteristic can be restored to a condition such that the capability of an item to function reliably and safely is unimpaired, even though that item still does not conform to the original requirement, the Contractor shall submit the non-compliance to the Owner for approval.

End